UNIVERSITY OF ALBERTA

# THE ROLE OF SEDIMENT BYPASSING IN SILICICLASTIC FACIES VARIABILITY ON THE CONTINENTAL SHELF: EXAMPLES FROM THE FRASER RIVER DELTA FORESLOPE AND THE MIDDLE TRIASSIC DOIG FORMATION.

BY ©
RICHARD WENDELL EVOY

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Dr. T.F. Moslow
DATE: Sept. 11/95

Dr. R.T. Patterson
DATE: July 10/95

Dr. J.L. Luternauer
DATE: July 30/95

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Dr. T.F. Moslow
DATE: Sept. 11 /95

Ray Kostaschuk
Dr. R.A. Kostaschuk
DATE: July 18/95

John L. Luternauer
Dr. J.L. Luternauer
DATE: July 30/95

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Dr. T.F. Moslow

DATE: Sept. 11/95

John L. Luternauer

Dr. J.L. Luternauer

DATE: July 25/95

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Dr. T.F. Moslow

DATE: Sept. 11/95

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*A relatively active source may supply detritus to a slowly subsiding area slightly faster than it can be assimilated in terms of a profile of equilibrium. In such instances, the excess sediment may be by-passed to other depositional sites farther removed from the source ...... there is evidence from subsurface data that sediments may be carried across a neutral area to a depositional basin where more rapid subsidence provides conditions for rapid trapping of the sediment.*

Krumbein and Sloss (1951), Stratigraphy and Sedimentation

*Whatever made the world ... the scientist writes its laws. Whether or not nature behaves according to law depends entirely upon whether we succeed in writing laws that describe its behaviour.*

Nelson Goodman, Uniformity and Simplicity

UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled THE ROLE OF SEDIMENT BYPASSING IN SILICICLASTIC FACIES VARIABILITY ON THE CONTINENTAL SHELF: EXAMPLES FROM THE FRASER RIVER DELTA FORESLOPE AND THE MIDDLE TRAISSIC DOIG FORMATION, submitted by RICHARD WENDELL EVOY in partial fulfillment of the requirements for the degree of DOCTOR OF PHILOSOPHY.

Dr. T.F. Moslow - Supervisor

Dr. S.G. Pemberton

Dr. N.W. Rutter

Dr. P.K. Robertson - Civil Engineering

J.V. Barrie

Dr. J.V. Barrie - External Examiner

DATE: SEPT. 15, 1995

## ABSTRACT

Two examples of sediment bypassing and deposition during an abrupt fall of relative sea level on the continental shelf were examined to document facies characteristics and depositional geometries in marine sandstones associated with sediment bypassing, and to determine if criteria are available to distinguish between forced regression shorefaces and other sharp-based sand bodies.

Several models exist for the development of "sharp-based shelf sands" associated with falling sea level. The Doig represents an archetypal forced regression shoreface characterized by linear shoreface sandstones overlying offshore siltstones and shales across an erosional discontinuity demarcated by a *Glossifungites* surface, and truncation of underlying lithologies. The development of lowstand shorefaces reflects an abrupt fall in relative sea level, and represents a necessary response to decreasing accomodation space independant of the mechanism of sea level fall. The forced regression model accounts for sand bypassing by bringing the shoreface to "deep-water".

Sharp-based sands are often *assumed* to represent forced regression shorefaces. Sand deposition on the Fraser River delta foreslope is in the form of small depositional lobes where subaqueous channels debouche at the base of the foreslope. Upslope channel migration and abandonment, and coalesence of depositional lobes at the base of the delta foreslope, will result in the generation of a linear sand body. Sand bypassing is via discrete channels, and results in the transport of sediment from the shoreface, directly to "deep-water". In the absence of diagnostic sedimentologic criteria to determine the depositional environment, and documentation of a significant erosional discontinuity across the basal contact, this sand could be misinterpreted in the stratigraphic record as a forced regression shoreface. Linear, sharp-

based, shore-parallel sand bodies can be deposited in deep water; their geometry may not simply reflect fairweather wavebase scour and subsequent transgressive reworking *aka* the forced regression model.

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# CHAPTER 1.
# INTRODUCTION

## General Overview and Objectives

The significance of sediment bypassing in the delivery of sand to "deep-water" environments has been long recognized (Eaton, 1929; Straub, 1940; Krumbein and Sloss, 1951). The resultant sand bodies provide excellent hydrocarbon targets as they are frequently encased in marine silts and shales that provide both lateral and vertical seals as well as potential source rock. Furthermore, these sands may represent the sole remaining evidence for significant fluctuations in relative sea level.

Krumbein and Sloss (1951), in discussing the relationship between sedimentation and subsidence rate, appear to have anticipated our current understanding of the significance of accomodation space in controlling sediment bypassing. Since the advent of sequence stratigraphy in the early 1980's, much of the research in this area has focussed on the role of fluvial incision, associated with eustatic sea level changes and relative fall of sea level, in cross-shelf sediment transport (eg. Galloway *et al.*, 1977; Stuart and Caughey, 1977; Vail *et al.*, 1977; Kirk, 1985; Posamentier and Vail, 1988). It is only recently that alternative methods for sand bypassing have received significant interest (eg. Plint, 1988; 1991; Posamentier *et al.*, 1992; Walker and Plint, 1992).

Previous sequence stratigraphic studies have overemphasized the role of eustatic sea level change in sediment bypassing and deposition of shelf sands. Few studies have dealt specifically with the significance of tectonically driven relative sea level falls in the initiation of bypass systems. This study was undertaken to document some of the variability in siliciclastic facies associated with sediment bypassing and deposition on the continental shelf during a non-eustatic (ie. relative) fall of sea level. Two examples were selected, each of which were associated with deposition under a relative sea level fall during a period of global eustatic sea level rise. They are: 1) the modern Fraser River delta foreslope offshore

Vancouver, British Columbia (Figure 1-1), and 2) the Middle Triassic (Anisian/Ladinian) Doig Formation in northeastern British Columbia, centered around the Buick Creek Field near Fort St. John (Figure 1-2).

The initial hypothesis, based on apparent geometric similarities, was that the subaqueous Fraser River delta might provide a process analogue with which to compare, contrast, and possibly model the Doig Formation in the Buick Creek Field. The objectives of the study were:

1) to determine the nature of lateral and vertical facies variability and geometry for subaqueous channels and lobes in the Fraser delta foreslope;
2) to document the role of sediment-gravity flow processes in the redistribution of sediment from the delta plain and foreslope to a pro-delta environment (sand bypassing); and
3) to apply these results to the reconstruction of facies relationships and internal architecture of shelf and shelf-edge sandstones, especially those deposited under similar conditions of sediment bypassing and/or mass-wasting.

As additional data were collected, several similarities which were initially considered significant, were seen to be largely superficial. This hypothesis was subsequently modified from one based on comparison to one based on contrast. However, the two examples represent variations of sediment deposition controlled by an abrupt fall in relative sea level during a period of global eustatic sea level rise.

Sediment delivery to the Fraser River delta foreslope is controlled by fluvial processes (point source), and modified by tidal redistribution. The area experiences a temperate climate, receives abundant annual precipitation, and drains a large, high-relief source area. The role of extrabasinal control (allocyclic processes) is significant. Seismic activity and slope instability may play a role in initiating the remobilization of sediment and, because of the interplay between isostatic rebound and eustatic sea level rise, the Fraser River delta has undergone a relative sea level fall followed by minimal transgression during a period of global

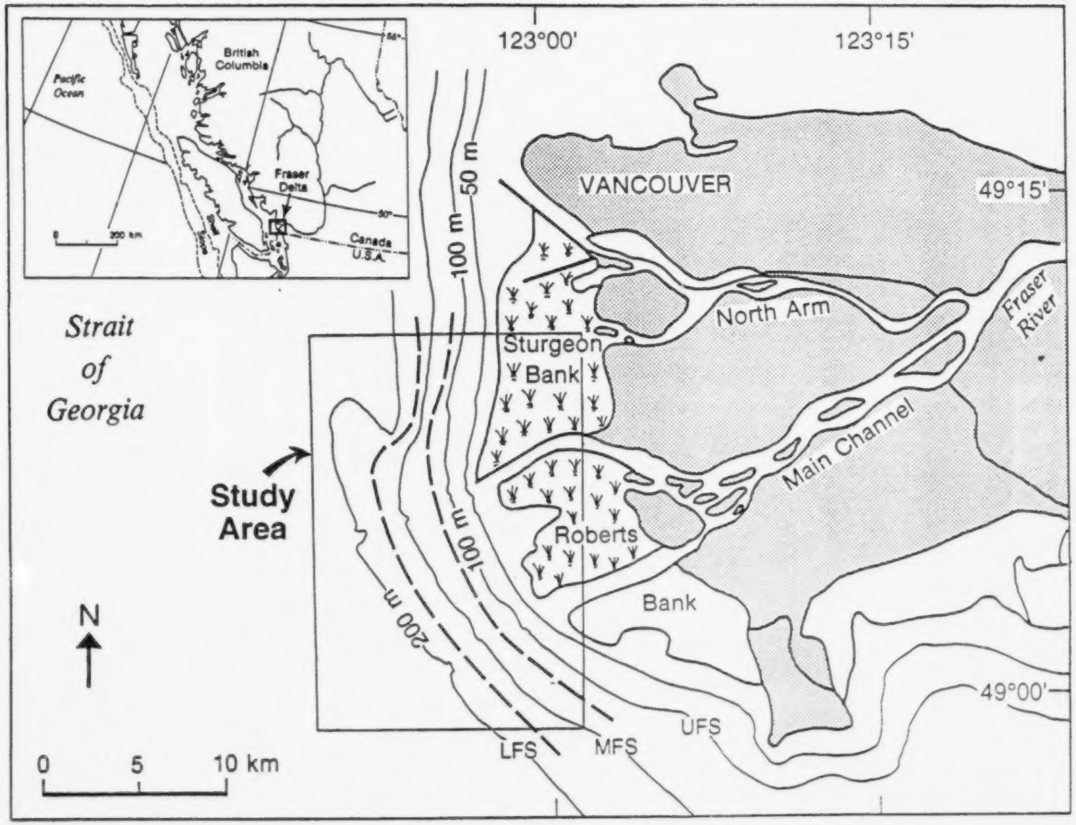

123°00'
123°15'
49°15'
49°00'
Pacific Ocean
British Columbia
Fraser Delta
Canada
U.S.A.
200 km
Strait of Georgia
VANCOUVER
North Arm
Fraser River
Main Channel
Sturgeon Bank
Roberts Bank
50 m
100 m
200 m
UFS
MFS
LFS
Study Area
N
0
5
10 km

Figure 1-1. Fraser River delta study area location map with generalized bathymetry and main physiologic elements of the foreslope. Grass pattern represents the tidal flat; UFS, MFS and LFS refer to upper, middle and lower foreslope areas. (modified from Evoy and Moslow, 1995a).

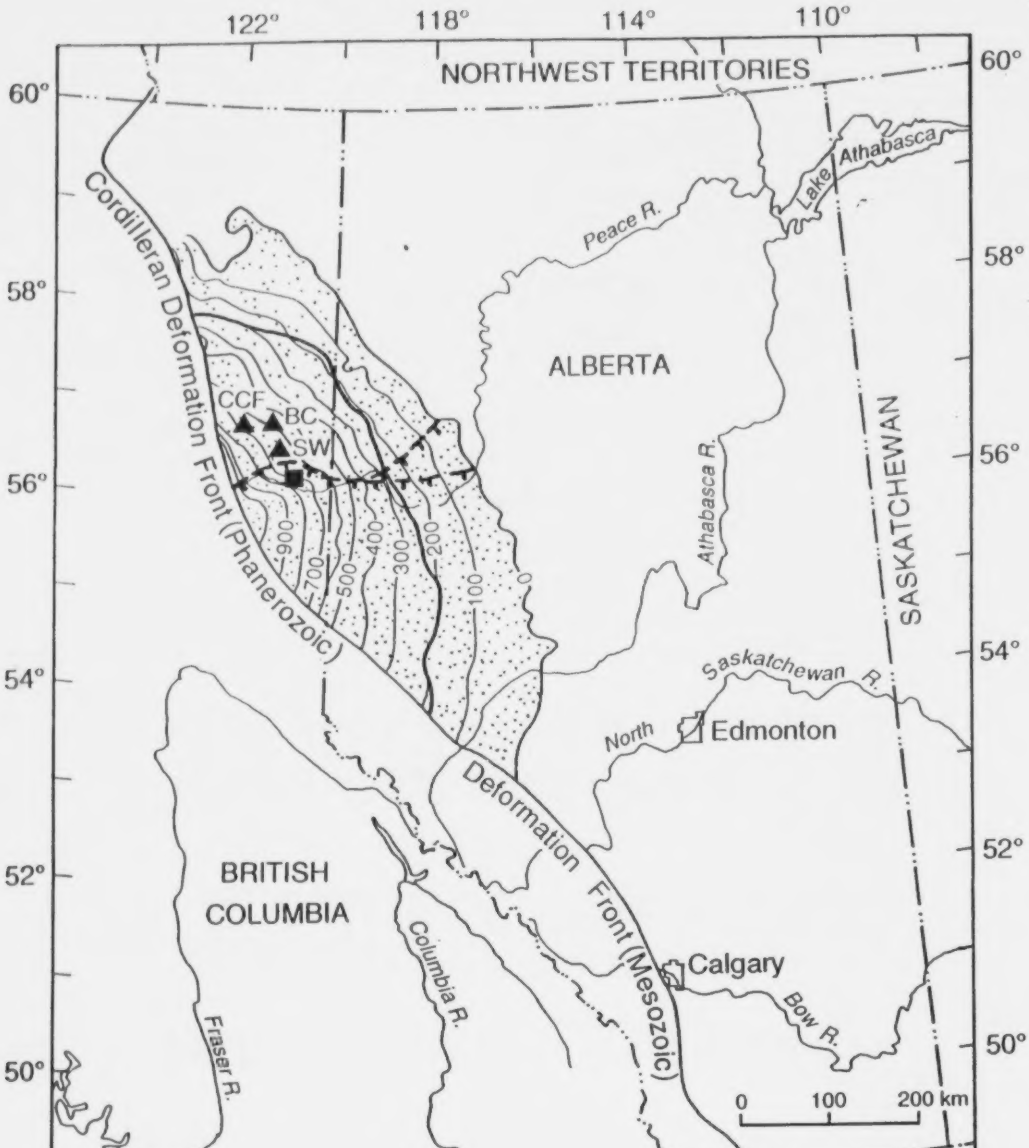

NORTHWEST TERRITORIES
ALBERTA
SASKATCHEWAN
BRITISH COLUMBIA
Cordilleran Deformation Front (Phanerozoic)
Deformation Front (Mesozoic)
Peace R.
Lake Athabasca
Athabasca R.
North Saskatchewan R.
Edmonton
Calgary
Bow R.
Columbia R.
Fraser R.
CCF
BC
SW
900
700
500
400
300
200
100
0
0 100 200 km
122°
118°
114°
110°
60°
58°
56°
54°
52°
50°
120°
116°
112°

Figure 1-2. Regional Doig study location map with Triassic isopach and location of Buick Creek (BC), Cache Creek/Fireweed (CCF) and Stoddart-West (SW) fields denoted by solid triangles. Solid square marks the site of the municipality of Fort St. John. Contour interval for Triassic isopach equals 100 metres, solid heavy line approximating the 200 m contour represents the erosional edge of the Halfway/Doig interval. Heavy dashed lines represent the flanks of the Dawson Creek Graben Complex. Modified from Edwards *et al.* (1994) and Henderson *et al.* (1994).

sea level rise (ie. eustatic sea level rise has been less than isostatic uplift). The Fraser River delta is protected from significant storm-wave influence by Vancouver Island and the limited fetch across the Strait of Georgia, and progrades directly into a deep water environment.

There is no documented point source for the Doig sands. While this may be due in part to post-depositional erosion of continental facies along the subcrop edge, the generally arid climatic conditions prevailing during Triassic time are incompatible with significant precipitation and development of fluvial systems in the hinterland. The Doig Formation appears to reflect intrabasinal controls (autocyclic processes) dominated by an abrupt relative sea level fall during a larger-scale sea level rise. Evidence of soft-sediment deformation and oversteepened bedding provide evidence for substrate instability. There may be an additional tectonic control on sandstone body geometries induced by ongoing reactivation of basement faults and the Dawson Creek Graben Complex.

## Fraser River Delta Foreslope

### *General*

Sedimentary facies distributions from the Fraser River delta foreslope have been correlated with 3.5 kHz seismic data and textural parameters. This provides a large, integrated data set with which to address the questions of sediment dispersal and transport patterns, and the relative significance of sediment gravity flows in the delivery of sediment to deep water. The unique geographic setting, and the presence of sand sized clastic detritus being introduced directly into water depths in excess of 200 metres, may ultimately serve as an analogue to lowstand (shelf-edge) deltas and/or ramp-margin turbidite fans (channel/lobe complexes).

### *Geologic Setting*

The Fraser River delta lies offshore the greater Vancouver area in Georgia Strait. It is a large delta actively prograding into water depths greater than 200 m (Figure 1-1). The Fraser River drainage basin includes 250,000 km$^2$ of high relief mountainous terrain. Mean annual precipitation varies greatly throughout the basin, from less than 30 cm in the upper Fraser River valley, to greater than 450 cm in the Coquitlam Valley in the lower reaches of the drainage basin (Johnston, 1921). Peak discharge coincides with the snowmelt freshet in late spring and early summer (Milliman, 1980). A pronounced tidal influence is superimposed on the lower reaches of the Fraser River with semi-diurnal tides approaching 5 m at the river mouth (Kostaschuk *et al.*, 1992a).

Inception of sedimentation in the Holocene Fraser River delta was coupled with up to 200m of isostatically driven fall in local sea level between 13,000 and 8,000 years ago (Clague *et al.*, 1982; Figure 1-3a). The ensuing transgression during Recent time is on the order of 12 metres (Williams and Roberts, 1989; Figure 1-3b). The delta is sourced with relatively coarse-grained detritus via strongly seasonal fluvial discharge (Kostaschuk *et al.*, 1989), experiences large tidal draw down, and exists within one of the most active seismic regimes in Canada (Luternauer, 1988). The area is also protected from excessive storm - generated waves by the limited fetch across Georgia Strait.

The seaward margin of the delta consists of a series of broad tidal flats up to 9 km in width, with an average slope of less than 0.1°. The foreslope extends a further 5 to 10 km seaward at an average slope of 1.5°, and is cut by a number of broad "sea valleys" hundreds of metres wide, floored in medium sand, and up to 10 m in relief (Kostaschuk *et al.*, 1992b; Hart *et al.*, 1992; Evoy *et al.*, 1993a). Much of the coarsest sediment supplied to the mouth of the delta bypasses the delta plain and upper foreslope to be introduced directly to the lower foreslope and basin floor. Sediment bypassing is via turbidity currents within these subaqueous channels, and deposition occurs where these channels debouche onto the basin floor as a series of sand-rich depositional lobes in approximately 200 to 250 m water depth (Moslow *et al.*, 1991; 1993; Evoy *et al.*, 1993b). Development of multiple channels through time on the delta foreslope has resulted in a high degree of along-slope facies variability and sand deposition in water depths exceeding 200 metres.

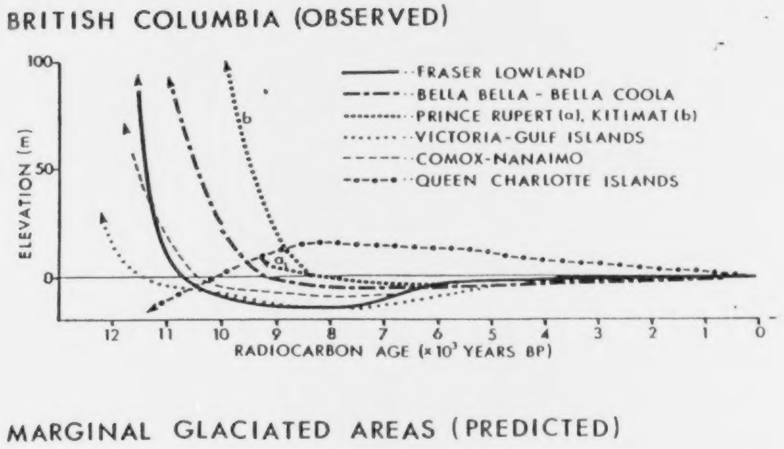


Figure 1-3a. Holocene sea level curve for the lower mainland area (Fraser River delta). (from Clague *et al.*, 1982).

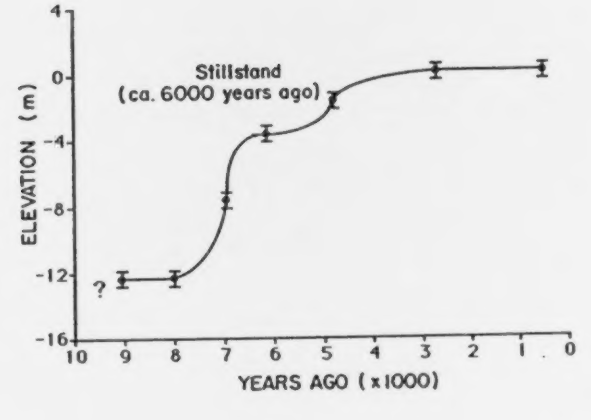


Figure 1-3b. Revised sea level curve for the Fraser Lowland showing the magnitude of Holocene transgression following the initial sea level fall. (from Williams and Roberts, 1989).

*Database and Methodology*

This study was undertaken in conjunction with the Geological Survey of Canada to integrate detailed sedimentologic core descriptions with sediment accumulation rates, textural analysis of selected cores, and high frequency seismic profiles in order to study the origin, geometry and variability of sedimentary facies in submarine channels ("sea valleys") and associated depositional lobes of the delta foreslope. Elements of the study have been published on an ongoing basis as follows: sediment accumulation rates (CHAPTER 2; Evoy, 1992; Evoy *et al.*, 1993a; Moslow *et al.*, 1993); grain size distribution patterns and textural analysis (CHAPTER 3; Evoy and Moslow, 1995a; Evoy *et al.*, *submitted*); sedimentary facies associations (CHAPTER 4; Evoy *et al.*, 1994); and, implications for sediment bypassing (CHAPTER 5; Evoy and Moslow, 1995a; Moslow *et al.*, 1995).

The delta foreslope is bisected by two pronounced bathymetric channels. The Sand Heads Sea Valley, off the Main Arm of the Fraser River, is the only active channel on the foreslope; consequently, most studies of sediment transport and failure on the subaqueous delta have concentrated on this area (eg. Kostaschuk *et al.*, 1989; Hart *et al.*, 1992; Kostaschuk *et al.*, 1992b; McKenna *et al.*, 1992). Due to the requirements of navigation, the Main Arm has experienced significant cultural modifications, including construction of the Steveston Jetty and continually dredging. The Roberts Bank channel is currently inactive, and predates any appreciable anthropogenic mediation. It therefore more accurately reflects the natural state of sedimentation on the subaqueous Fraser River delta, and was thus emphasized in this study.

The data set for this study consists of 86 vibrocores, piston cores and gravity cores (Figure 1-4a; Appendix A). Fifty-five of these core were described, and an additional 31 core descriptions were provided by the Pacific Geoscience Centre of the Geological Survey of Canada (Table 1-1; Appendix B). The Geological Survey of Canada also provided access to several hundred kilometers of high frequency seismic lines (Figure 1-4b), and side-scan sonar survey coverage concentrating on the immediate vicinity of the major subaqueous channels

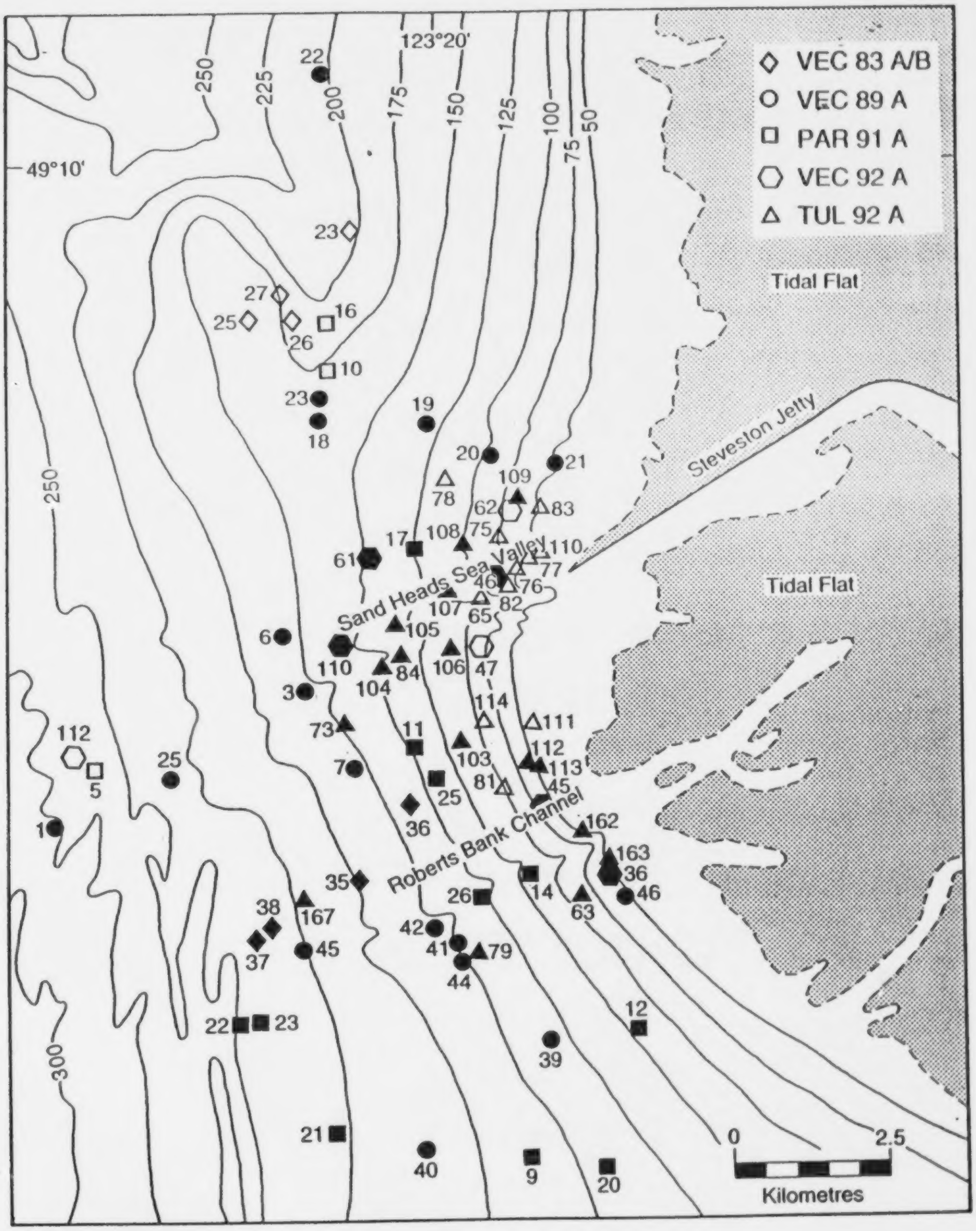
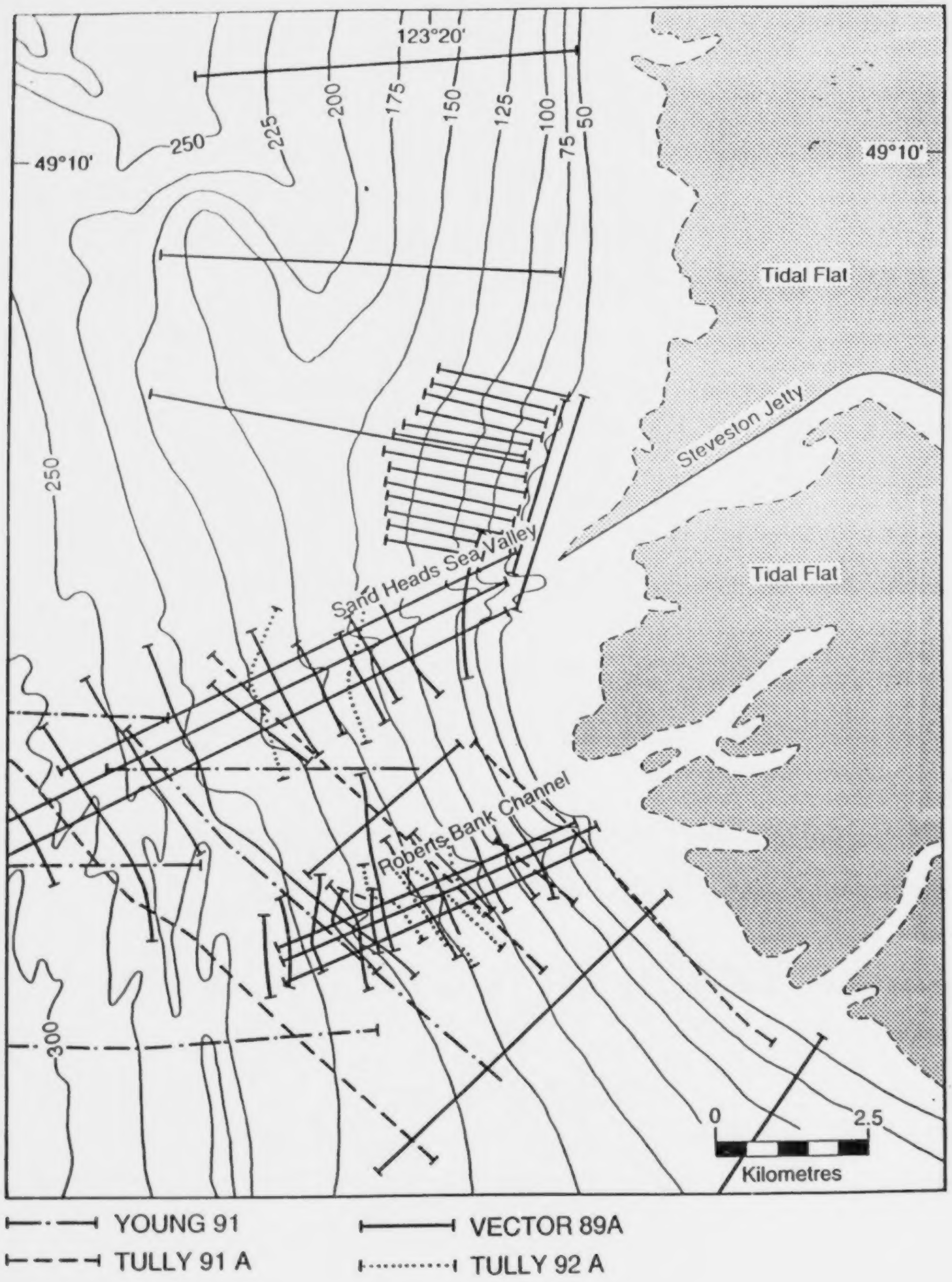

123°20'
49°10'
◇ VEC 83 A/B
○ VEC 89 A
□ PAR 91 A
⬡ VEC 92 A
△ TUL 92 A
250
225
200
175
150
125
100
75
50
250
300
Tidal Flat
Tidal Flat
Steveston Jetty
Sand Heads Sea Valley
Roberts Bank Channel
0
2.5
Kilometres
22
23
27
25
26
16
10
23
18
19
20
21
109
78
62
83
17
108
75
110
77
61
46
76
82
107
65
105
6
110
84
104
106
47
3
114
111
73
11
103
112
113
112
5
25
7
25
81
45
36
162
1
35
163
36
14
26
46
63
38
167
37
45
42
41
79
44
22
23
12
39
21
40
9
20

Figure 1-4a. Detailed bathymetry of the Fraser River delta foreslope in the study area with location of sediment cores collected during five separate cruises. Core sites denoted with closed symbols are presented in Appendix B.


123°20'
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125
100
75
50
49°10'
49°10'
Tidal Flat
Steveston Jetty
Tidal Flat
Sand Heads Sea Valley
Roberts Bank Channel
250
300
0
2.5
Kilometres
YOUNG 91
TULLY 91 A
VECTOR 89A
TULLY 92 A

Figure 1-4b. Detailed bathymetry of the Fraser River delta foreslope in the study area with traces of high-frequency seismic lines.

Table 1-1. Table of sediment cores collected from the subaqueous Fraser River delta used in this study.

| CORE I.D. | WATER DEPTH | CORE LENGTH | CORE TYPE |
|---|---|---|---|
| VEC 83A - 23 | 231 m | 150 cm | GRAVITY |
| 25 | 163 m | 135 cm | GRAVITY |
| 26 | 185 m | 151 cm | GRAVITY |
| 27 | 183 m | 154 cm | GRAVITY |
| VEC 83B - 35 | 202 m | 67 cm | GRAVITY |
| 36 | 152 m | 164 cm | GRAVITY |
| 37 | 241 m | 31 cm | GRAVITY |
| 38 | 240 m | 62 cm | GRAVITY |
| VEC 89A - 1 | 280 m | 580 cm | PISTON |
| 3 | 190 m | 220 cm | PISTON |
| 6 |  | 106 cm | PISTON |
| 7 |  | 465 cm | PISTON |
| 18 | 170 m | 381 cm | PISTON |
| 19 | 136 m | 460 cm | PISTON |
| 20 | 93 m | 420 cm | PISTON |
| 21 | 50 m | 423 cm | PISTON |
| 22 | 206 m | 510 cm | PISTON |
| 23 | 174 m | 188 cm | PISTON |
| 25 | 240 m | 137 cm | PISTON |
| 39 | 163 m | 132 cm | PISTON |
| 40 | 212 m | 486 cm | PISTON |
| 41 |  | 145 cm | PISTON |
| 42 | 176 m | 62 cm | PISTON |
| 44 | 182 m | 280 cm | PISTON |
| 45 | 231 m | 165 cm | PISTON |
| 46 | 46 m | 101 cm | PISTON |
| PAR 91A - 3 | 76 m | 228 cm | VIBRACORE |
| 9 | 188 m | 372 cm | PISTON |
| 10 | 175 m | 212 cm | PISTON |
| PAR 91A - 11 | 143 m | 438 cm | PISTON |
| 12 | 120 m | 362 cm | PISTON |
| 14 | 120 m | 402 cm | PISTON |
| 17 | 126 m | 437 cm | PISTON |
| 20 | 173 m | 290 cm | PISTON |
| 21 | 228 m | 503 cm | PISTON |
| 22 | 249 m | 374 cm | PISTON |
| 23 | 239 m | 387 cm | PISTON |
| 25 | 145 m | 340 cm | PISTON |
| 26 | 160 m | 468 cm | PISTON |
| VEC 92A - 20 | 174 m | 230 cm | GRAVITY |
| 34 | 129 m | 375 cm | PISTON |
| VEC 92A - 35 | 51 m | 108 cm | PISTON |
| 36 | 44 m | 535 cm | PISTON |
| 45 | 60 m | 498 cm | PISTON |
| 46 | 59 m | 248 cm | PISTON |
| 47 | 71 m | 514 cm | PISTON |
| 61 | 152 m | 578 cm | PISTON |
| 62 | 36 m | 385 cm | PISTON |
| 104 | 215 m | 71 cm | GRAVITY |
| 105 | 268 m | 80 cm | GRAVITY |
| 106 | 281 m | 77 cm | GRAVITY |
| 107 | 343 m | 88 cm | GRAVITY |
| 108 | 285 m | 88 cm | GRAVITY |
| 109 | 253 m | 75 cm | GRAVITY |
| 110 | 151 m | 392 cm | PISTON |
| 112 | 274 m | 580 cm | PISTON |
| TUL 92A - 62 | 40 m | 140 cm | VIBRACORE |
| 63 | 80 m | 234 cm | GRAVITY |
| 64 | 96 m | 189 cm | GRAVITY |
| 65 | 82 m | 39 cm | GRAVITY |
| 66 | 68 m | 244 cm | GRAVITY |
| 74 | 178 m | 555 cm | PISTON |
| 75 | 52 m | 393 cm | PISTON |
| 76 | 39 m | 410 cm | PISTON |
| 77 | 46 m | 397 cm | PISTON |
| 78 | 122 m | 155 cm | PISTON |
| 79 | 173 m | 447 cm | PISTON |
| 81 | 59 m | 402 cm | PISTON |
| 82 | 55 m | 164 cm | PISTON |
| 83 | 66 m | 138 cm | PISTON |
| 84 | 136 m | 232 cm | GRAVITY |
| 103 | 115 m | 63 cm | GRAVITY |
| 104 | 153 m | 34 cm | GRAVITY |
| 105 | 140 m | 206 cm | GRAVITY |
| 106 | 107 m | 98 cm | GRAVITY |
| 107 | 105 m | 198 cm | GRAVITY |
| 108 | 98 m | 194 cm | GRAVITY |
| 109 | 70 m | 191 cm | GRAVITY |
| 110 | 55 m | 230 cm | GRAVITY |
| 111 | 20 m | 185 cm | GRAVITY |
| 112 | 61 m | 33 cm | GRAVITY |
| 113 | 59 m | 239 cm | GRAVITY |
| 114 | 93 m | 134 cm | GRAVITY |
| 162 | 51 m | 215 cm | VIBRACORE |
| 163 | 54 m | 199 cm | VIBRACORE |
| 167 | 221 m | 227 cm | GRAVITY |

and their associated depositional lobes.

Detailed descriptions of all cores concentrated on the documentation of sedimentary textures and structure. To compliment these standard sedimentologic elements, grain size and textural analysis of 124 samples from 22 cores collected on the delta foreslope were completed (Appendix C). These data delineate facies variability trends in sands deposited as depositional lobes at the mouths of subaqueous channels, and constrain their causative depositional processes. These data were supported by an additional 135 analyses, from 20 cores, provided by the Geological Survey of Canada.

## Doig Formation Sedimentology and Stratigraphy

### *General*

Recent gas resource assessments for the Western Canada Sedimentary Basin suggest that the most promising play in the Triassic interval is the Halfway/Doig Shelf in northeastern British Columbia, with estimated reserves of 4 TCF (Bird *et al.*, 1994). Within the Doig Formation, the productive sands are preserved as narrow, elongate, shore-parallel sandstones encased in shelf siltstones and shales.

A two-phase approach has been taken to document the role of sediment bypassing in the delivery of sand to a shelfal environment in the Doig Formation. A detailed study of the largest producing Doig field in northeastern British Columbia - Buick Creek - was undertaken to document depositional processes and facies distributions in the Buick Creek Field (CHAPTER 6; Evoy and Moslow, 1995b; Evoy and Moslow, *in press*), and to establish a depositional model for the Doig sandstones. This depositional framework was then extended regionally to test for similarities between Doig facies from a number of different localities, and determine their stratigraphic relationships (CHAPTER 7).

### *Geologic Setting*

Middle Triassic strata of northeastern British Columbia represent a progradational sequence of marine to shallow marine clastic sediments deposited on the western flank of the North American craton (Gibson and Barclay, 1989). The climate is considered to have been hot and extremely arid during this period, both locally (Campbell and Horne, 1986) and globally (Parrish, 1993). Paleolatitude was approximately 30° north of the equator (Habicht, 1979).

Although 3rd order eustatic sea level fluctuations have been recognized globally in the Anisian and Ladinian (Haq *et al.*, 1988; Embry, 1988; Figure 1-5), the validity of this curve and the relative importance of tectonics in modifying global sea level signatures in the Triassic has been questioned (Embry, 1988; van Veen *et al.*, 1992; de Zanche *et al.*, 1993; Yose, 1994). The actual number of 3rd order sequences developed during this time period, and their correlatability, is similarly under debate. Haq *et al.* (1988) recognize two 3rd order sequences in the Middle Triassic, corresponding (approximately) to the Anisian and Ladinan stages. De Zanche *et al.* (1993), working in one of the Haq *et al.* (1988) type areas in the Dolomites, Italy, document four 3rd order Anisian sequences and three Ladinian 3rd order sequences. Rasmussen *et al.* (1992) recognize five Anisian depositional sequences in the Barents Sea.

In the subsurface, middle Triassic strata are subdivided into two broad lithostratigraphic units; the Doig Formation and the overlying Halfway Formation (Hunt and Ratcliffe, 1959; Armitage, 1962). The Doig Formation is often defined as the deep water facies equivalent to the shallow marine clastics of the Halfway Formation (eg. Willis, 1992); however, such usage makes the *a priori* assumption that any sandstones completely encased within the siltstones and shales of the classic Doig assemblage must therefore represent deeper water sand deposition. The difficulty in differentiating between the basal Halfway and Doig formations is now generally accepted (eg: Edwards *et al.*, 1994; Gibson and Edwards, 1990), and the two are treated herein as a single, continuous unit (Table 1-2). These strata unconformably overlie the lower Triassic Montney Formation, and are abruptly overlain by marginal marine to non-marine clastics, evaporites and carbonates of the Charlie Lake Formation.

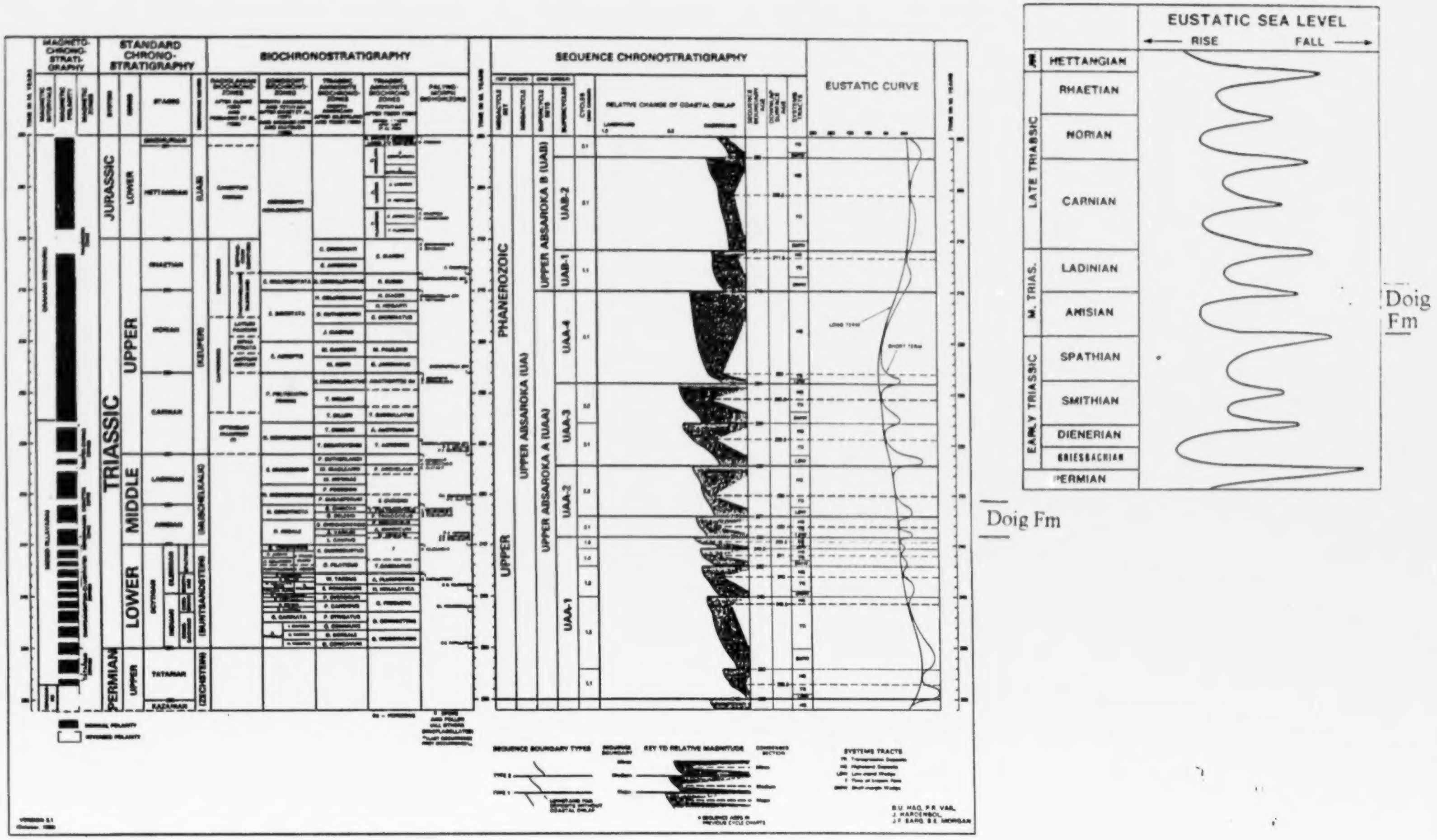
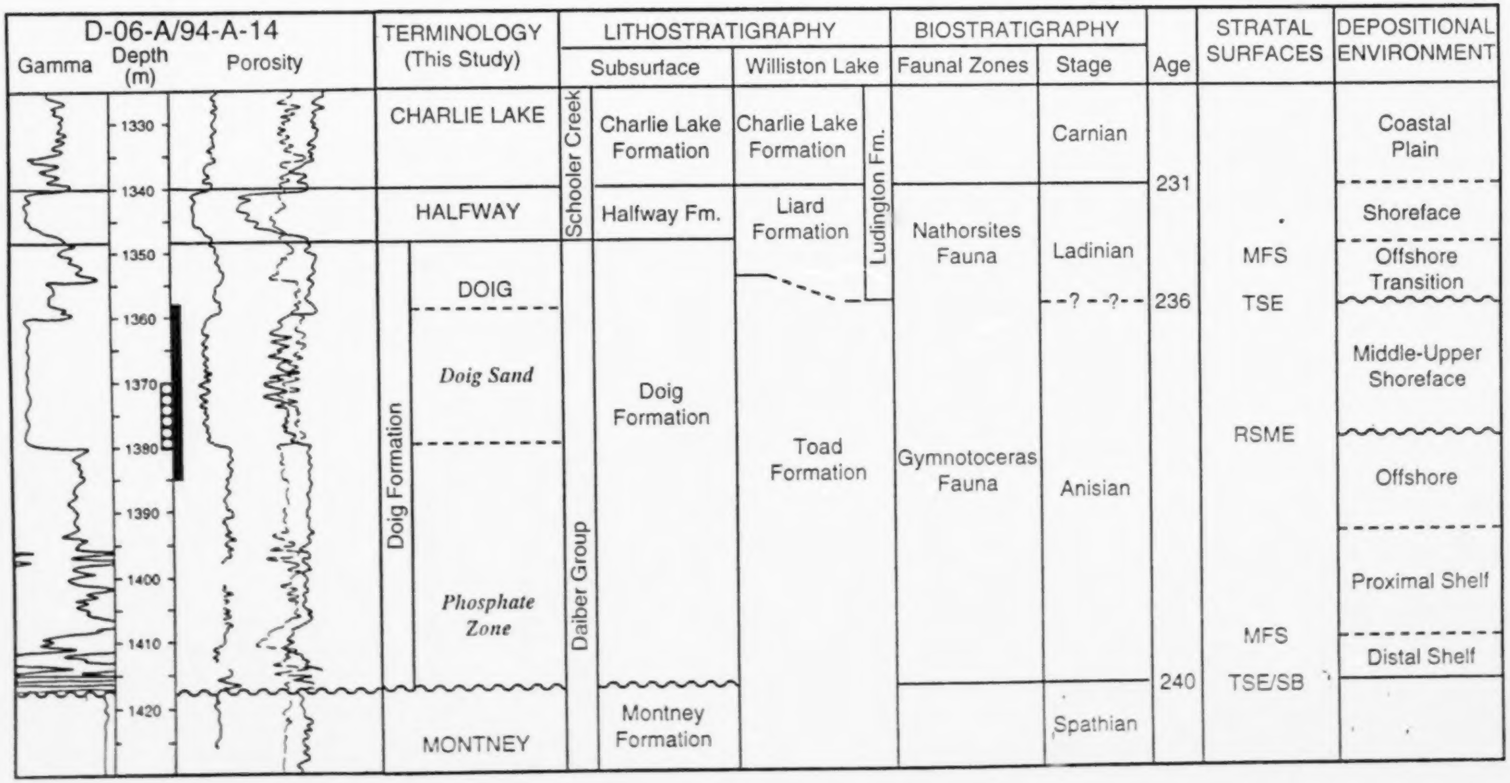


Figure 1-5. Triassic eustatic sea level curves from Haq *et al.*, 1988 (A) and Embry, 1988 (B).

Table 1-2. Stratigraphic correlation table for Middle Triassic strata in northeastern British Columbia.


D-06-A/94-A-14
Gamma
Depth (m)
Porosity
1330
1340
1350
1360
1370
1380
1390
1400
1410
1420
TERMINOLOGY (This Study)
CHARLIE LAKE
HALFWAY
DOIG
Doig Sand
Phosphate Zone
Doig Formation
MONTNEY
LITHOSTRATIGRAPHY
Subsurface
Williston Lake
Schooler Creek
Daiber Group
Charlie Lake Formation
Halfway Fm.
Doig Formation
Montney Formation
Charlie Lake Formation
Liard Formation
Ludington Fm.
Toad Formation
BIOSTRATIGRAPHY
Faunal Zones
Stage
Nathorsites Fauna
Gymnotoceras Fauna
Carnian
Ladinian
--? --?--
Anisian
Spathian
Age
231
236
240
STRATAL SURFACES
MFS
TSE
RSME
MFS
TSE/SB
DEPOSITIONAL ENVIRONMENT
Coastal Plain
Shoreface
Offshore Transition
Middle-Upper Shoreface
Offshore
Proximal Shelf
Distal Shelf

A number of anomalously thick sandstone bodies and bioclastic sandstones and conglomerates have been recognized in the Doig Formation in northwestern Alberta and northeastern British Columbia. These sandstones form narrow, elongate trends preserved within interlaminated siltstones and shales, and have been variously interpreted as fluvial valleys (Campbell and Horne, 1986), tidal channels, barrier islands and tidal flats (Aukes and Webb, 1986), estuarine channels incised into shallow shelf sediments (Cant, 1986), and sediment-gravity flows associated with shoreface failure and deposition at the shelf-slope break (Wittenberg, 1992; Qi, 1995). In northwestern Alberta, these reservoirs are oriented sub-parallel to paleo-bathymetry, contain trace fossil assemblages indicative of marine deposition, are interbedded with thin zones of hummocky cross-stratification (HCS), and exhibit internal facies distributions compatible with sediment transport normal to the paleo-shoreline (Wittenberg, 1992).

### *Database and Methodology*

The Buick Creek Field in northeastern British Columbia represents the largest recognized Doig reservoir in the study area, and constitutes the greatest single database available for subsurface reconstruction of a Doig pool. A total of 51 wells penetrate the Halfway/Doig interval in the immediate Buick Creek field area (Figure 1-6); 22 of these wells have been cored, and all available core has been logged (Table 1-3).

An additional 32 Lower Halfway/Doig cores are available in the regional study area, for a total of 54 cored wells totalling 1152 m (Appendix D). As most of these cores are within the immediate vicinity of producing fields, 475 wireline logs from wells penetrating the Doig Formation were used to constrain correlations between fields. To test for structural representation of the Doig sand body trends, a further 247 Halfway penetrations were checked (Appendix E). Simplified core descriptions and graphic logs for all cores are presented in Appendix F.

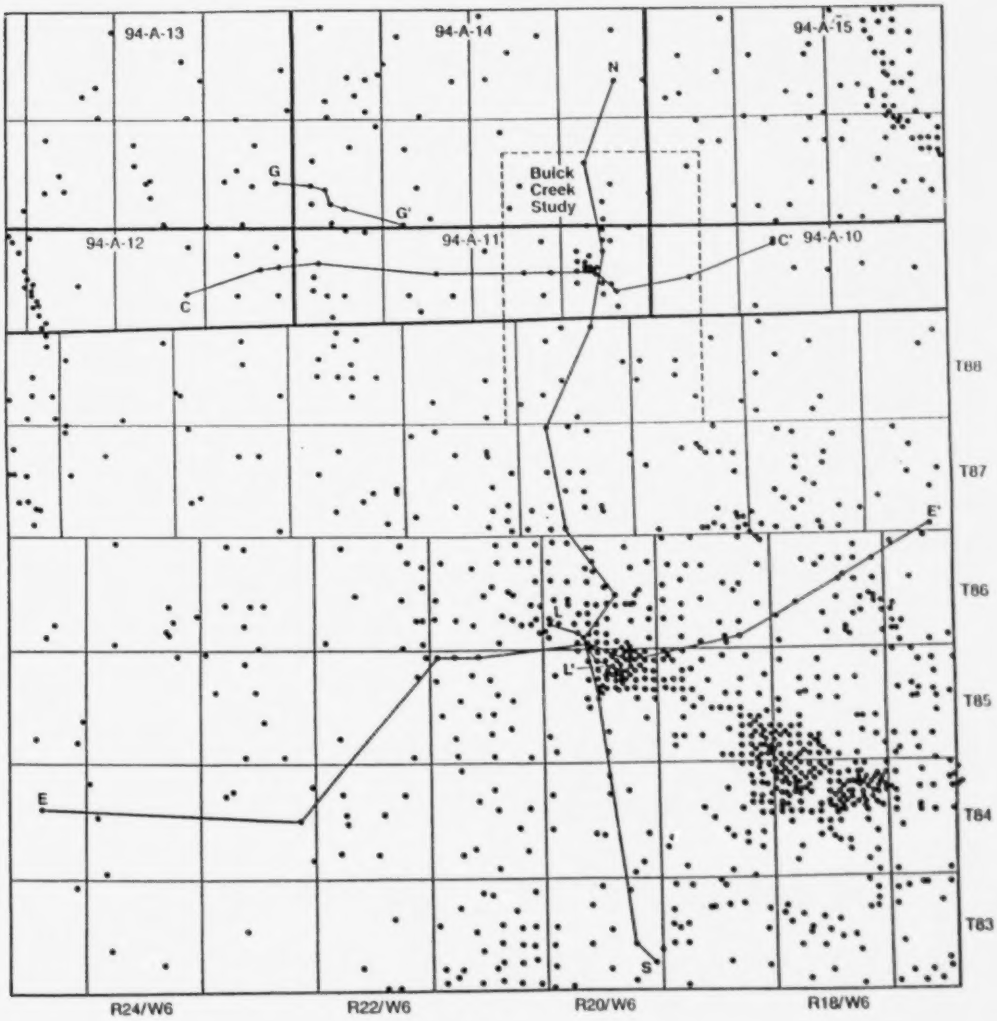

94-A-13
94-A-14
94-A-15
94-A-12
94-A-11
94-A-10
Buick Creek Study
N
S
G
G'
C
C'
E
E'
L'
T88
T87
T86
T85
T84
T83
R24/W6
R22/W6
R20/W6
R18/W6

Figure 1-6. Doig study area map showing all Halfway penetrations. All wells with core recovered from the Doig and/or Lower Halfway intervals have been logged as part of this study (see also Table 1-3). Cross sections L-L', G-G', N-S, C-C' and E-E' are discussed in the Chapter 7.

Table 1-3. List of wells in the study area with core in the Lower Halfway/Doig interval.

| UWI | FORMATION(S) | CORE LENGTH | AREA |
|---|---|---|---|
| 8-18-80-17/w6 | Doig | 21.60 | Regional |
| 8-09-80-21/w6 | Doig | 4.00 | Regional |
|  | Doig | 9.95 | Regional |
| 11-34-84-15/w6 | Doig | 15.00 | Regional |
| 12-24-84-21/w6 | Doig | 14.85 | Regional |
| 11-31-85-21/w6 | Doig | 17.90 | Regional |
| (02) 6-04-86-20/w6 | Doig | 17.45 | Stoddart |
| 12-04-86-20/w6 | Doig | 17.47 | Stoddart |
| 16-15-86-20/w6 | Doig | 10.50 | Stoddart |
| 10-25-86-20/w6 | Doig | 17.30 | Stoddart |
| 10-19-87-19/w6 | ChLk - Doig | 37.80 | Stoddart |
| 6-22-87-20/w6 | Hfwy - Doig | 5.14 | Stoddart |
|  | Doig | 12.40 | Stoddart |
| (02) 6-26-87-21/w6 | Hfwy | 13.30 | Stoddart |
| 6-03-88-14/w6 | ChLk - Doig | 16.80 | Regional |
| 9-19-88-16/w6 | Hfwy - Doig | 18.39 | Regional |
| 6-21-88-19/w6 | ChLk - Hfwy | 15.00 | Regional |
| 7-24-88-20/w6 | Hfwy | 14.40 | Buick Creek |
| 9-34-88-20/w6 | Doig | 36.40 | Buick Creek |
| a-30-L/94-A-05 | Hfwy-Doig | 13.10 | Regional |
|  | Doig | 23.70 | Regional |
| a-29-K/94-A-10 | ChLk - Hfwy | 4.80 | Regional |
|  | Hfwy +/- Doig | 17.20 | Regional |
| d-67-K/94-A-10 | Hfwy | 13.75 | Regional |
| d-36-I/94-A-11 | Doig (+/- Hfwy) | 12.80 | Buick Creek |
| b-44-I/94-A-11 | Doig (+/- Hfwy) | 18.65 | Buick Creek |
| d-45-I/94-A-11 | Doig | 18.70 | Buick Creek |
| d-46-I/94-A-11 | Doig | 13.50 | Buick Creek |
| (02) d-57-I/94-A-11 | Doig | 25.00 | Buick Creek |
| d-58-I/94-A-11 | Doig | 18.10 | Buick Creek |
| d-68-I/94-A-11 | Doig | 23.90 | Buick Creek |
| d-69-I/94-A-11 | Doig | 22.00 | Buick Creek |
| d-76-I/94-A-11 | Hfwy? + Doig | 12.00 | Buick Creek |
|  | Doig | 18.00 | Buick Creek |
| b-77-I/94-A-11 | Doig | 12.10 | Buick Creek |
|  | Doig | 17.10 | Buick Creek |
| d-79-I/94-A-11 | Doig (+/- Hfwy) | 9.00 | Buick Creek |
| d-85-I/94-A-11 | Doig | 36.40 | Buick Creek |
| d-86-I/94-A-11 | ChLk - Hfwy (Doig?) | 18.10 | Buick Creek |
|  | Doig | 18.20 | Buick Creek |
| (02) d-96-I/94-A-11 | ChLk | 8.40 | Buick Creek |
|  | Doig | 27.00 | Buick Creek |
| (03) d-96-I/94-A-11 | Hfwy/Doig | 41.80 | Buick Creek |
| d-52-J/94-A-11 | Mntny | 18.20 | Buick Creek |
| b-64-I/94-A-12 | Doig | 17.88 | Cache Creek |
| d-06-A/94-A-14 | Hfwy/Doig | 28.00 | Buick Creek |
| a-26-A/94-A-14 | Doig | 22.20 | Buick Creek |
| d-35-A/94-A-14 | Hfwy/Doig | 21.70 | Buick Creek |
| d-58-A/94-A-14 | Hfwy/Doig | 36.00 | Buick Creek |
| b-06-D/94-A-14 | Doig | 15.00 | Fireweed |
| d-15-D/94-A-14 | Doig | 19.00 | Fireweed |
| b-26-D/94-A-14 | Doig | 17.13 | Fireweed |
| d-37-D/94-A-14 | Doig | 15.99 | Fireweed |
| b-56-D/94-A-15 | ChLk - Hfwy | 18.20 | Buick Creek |
| d-84-I/94-A-15 | Doig (+/- L.Hfwy?) | 25.50 | Wildmint |
| b-10-C/94-H-01 | Doig (+/- L.Hfwy?) | 19.00 | Regional |
| d-13-D/94-H-01 | Doig (+/- L.Hfwy?) | 9.00 | Regional |
|  | Doig (?) | 9.30 | Regional |
| b-57-D/94-H-01 | Doig (+/- L.Hfwy?) | 18.70 | Regional |
| d-15-A/94-H-02 | Doig (+/- L.Hfwy?) | 21.00 | Wildmint |
| b-24-A/94-H-02 | Doig (+/- L.Hfwy?) | 16.10 | Wildmint |
| d-26-A/94-H-02 | Doig (+/- L.Hfwy?) | 18.50 | Wildmint |
| d-34-A/94-H-02 | Doig (+/- L.Hfwy?) | 27.30 | Regional |

Description of all available cores concentrated on the documentation of process sedimentologic characteristics, with emphasis on sedimentary structures and textures indicative of specific depositional processes. These data were integrated with available down-hole logs to document the internal architecture of individual sedimentary facies. A total of nine sedimentary facies were recognized in the Buick Creek - Fireweed - Stoddart areas, and have been grouped into three environmental facies associations in ascending stratigraphic order: (1) offshore/shelf, (2) lower to upper shoreface, and (3) offshore transition. All production is from Facies Association 2, which erosively overlies Facies Association 1, and is abruptly overlain by Facies Association 3 across a pronounced transgressive lag. Facies Association 2 is interpreted to represent a lowstand shoreface within an overall progradational sequence.

## Summary

The objectives of this research are to determine the nature of lateral and vertical facies variability and geometry of channels and depositional lobes in the Fraser River foreslope and prodelta, and to document the role of sediment-gravity flow processes in redistribution of sediment from the delta plain into the prodelta environment. These data will be integrated with results from studies of selected Middle Triassic (Doig Formation) reservoirs in the Western Canada Sedimentary Basin to develop a model characterizing facies relationships in marine sandstones associated with sediment bypassing during a fall in relative sea level. The ultimate goal of this research is to document some of the facies variability in siliciclastic sediments associated with sediment bypassing and deposition on the continental shelf during a relative sea level fall.

The Fraser River delta foreslope is bisected by two pronounced bathymetric channels, or "sea valleys", 100's of metres wide, up to 10 metres in relief, and floored with fine- to medium-grained sand. These channels are believed to be initiated and maintained by sediment gravity flow processes related to periodic liquifaction and failure at the head of the foreslope.

Much of the coarsest sediment supplied to the mouth of the delta bypasses the delta plain and upper foreslope to be introduced directly to the lower foreslope and basin floor where these channels debouche onto the basin floor as a series of sand-rich depositional lobes, or as a series of small, isolated slump-bound turbidite basins. Incision of multiple channels on the Fraser River delta foreslope has resulted in a high degree of along-slope facies variability.

Results from the study of the Fraser River delta foreslope will be integrated with sedimentologic and stratigraphic analysis of hydrocarbon-producing clastic reservoirs in the Doig Formation in northeastern British Columbia. A number of anomalously thick sandstone bodies and bioclastic units have been recognized in the Doig Formation in northwestern Alberta and northeastern B.C. These sandstones form narrow, elongate trends preserved within "deeper water" interlaminated siltstones and shales, are oriented sub-parallel to the paleo-shoreline, are interbedded with zones of hummocky cross-stratification, and exhibit internal facies distributions compatible with sediment transport (bypass) normal to the paleo-shoreline.

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# CHAPTER 2.

# PATTERNS AND VARIABILITY IN SEDIMENT ACCUMULATION RATES, FRASER RIVER DELTA FORESLOPE, BRITISH COLUMBIA[1]

## Introduction

Minimum sediment accumulation rates have been calculated for selected piston cores collected from the Fraser River delta foreslope during a 1989 research cruise of the *CSS Vector* (Moslow *et al.*, 1991). In addition, a qualitative assessment of sediment remobilization has been determined through analysis of micropaleontologic assemblages from cored sediment. Objectives of this study were to present a first approximation of the sources, rates and patterns of sedimentation on the delta slope, and to analyze their implications for sediment stability conditions.

Previous studies have focused on the subaerially exposed portion of the delta, on Holocene accretion of the delta (Clague *et al.*, 1991; Hart *et al.*, 1992), and on diurnal to annual fluctuations in sediment dynamics. This study focuses on patterns and variations in sediment accumulation rates over the 36 year period from 1953 to 1989, as determined from Cesium-137 profiles. These results shed light on identifying and predicting the specific mechanisms and frequency of sedimentation events on this, and other, subaqueous deltaic environments.

### *Geologic Setting*

The Fraser River delta, offshore Vancouver, British Columbia, is the largest delta on Canada's Pacific coast (Figure 2-1). The Fraser River drains approximately 250,000 km$^2$ of mountainous terrain with peak discharge during the snowmelt freshet in late spring and early summer (Milliman, 1980). Within the Fraser River estuary, a pronounced tidal influence is

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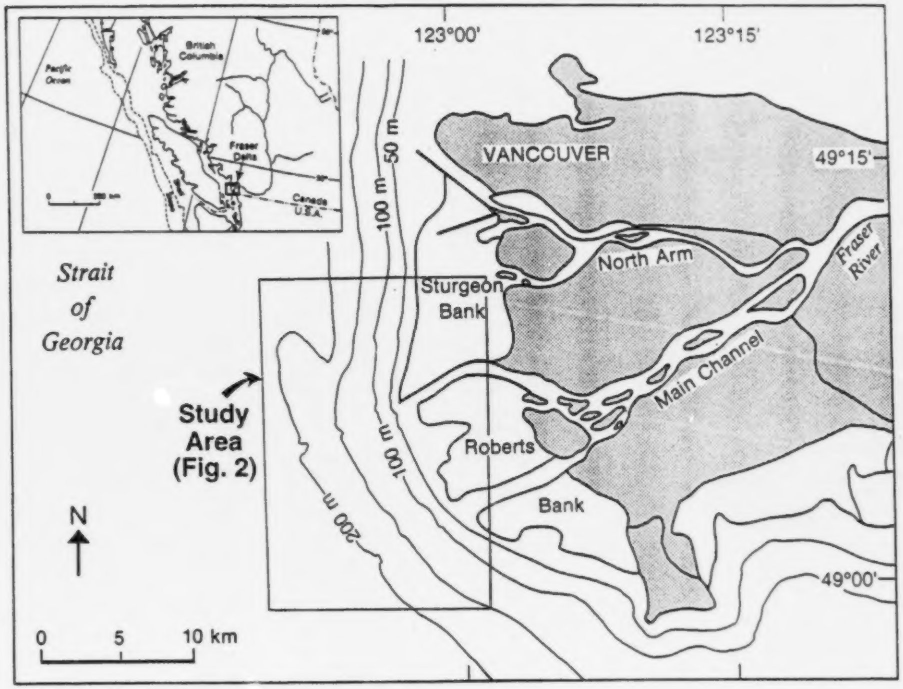
Pacific Ocean
British Columbia
Fraser Delta
Canada
U.S.A.
123°00'
123°15'
49°15'
49°00'
VANCOUVER
North Arm
Fraser River
Main Channel
Sturgeon Bank
Roberts Bank
50 m
100 m
100 m
200 m
Strait of Georgia
Study Area (Fig. 2)
N
0
5
10 km

Figure 2-1. Study area location map. Area enclosed within rectangular box is detailed in Figure 2-2. (Modified from Moslow *et al.* 1991, Kostaschuk *et al.* 1992).

superimposed on the fluvial regime; semi-diurnal tides at the river mouth can approach 5 m (Kostaschuk *et al.*, 1989). Tidal range within the estuary decreases upstream and with increasing discharge; in conjunction with fluvial discharge, this produces a pronounced salt-wedge which strongly affects local sedimentation rates and mechanics (Kostaschuk and Luternauer, 1989).

The Fraser River delta plain consists of a series of broad tidal flats up to 9 km wide with average slopes of less than 0.1°. The delta foreslope extends a further 5-10 km seaward at an average slope of 1.5°. The study area consists of 150 $km^2$ in the delta foreslope (Figure 2-2). Water depths in the study area range from less than 50 m to greater than 250 m. Average gradient of the slope in the study area is approximately 3.0°, but locally exceeds 6°.

Several submarine channels dissect the delta foreslope. These channels have up to 10 m relief and extend from the seaward terminus of the tidal flats or distributary mouth, to water depths in excess of 200 m (Figure 2-2). The largest, and currently active, of these is the Sand Heads Sea Valley.

### *Database and Methodology*

Cesium-137 is a radiogenic isotope produced as a byproduct of the testing of nuclear weapons. Global distribution of Cs-137 in surface sediments represents fallout from atmospheric testing. Vertical accretion rates of undisturbed recent sediments worldwide can be calculated based on the first appearance and maximum concentration of Cs-137 in recent sediments.

Detailed sedimentologic descriptions show that the cored intervals used in this study are essentially non-burrowed (Moslow *et al.*, 1991). The assumptions made in calculating sediment accumulation rates in this study were thus: 1) first appearance of Cs-137 represents the initiation of widespread atmospheric testing in 1954; and, 2) tailing effects of relatively low concentrations due to bioturbation are negligible in the cores selected.

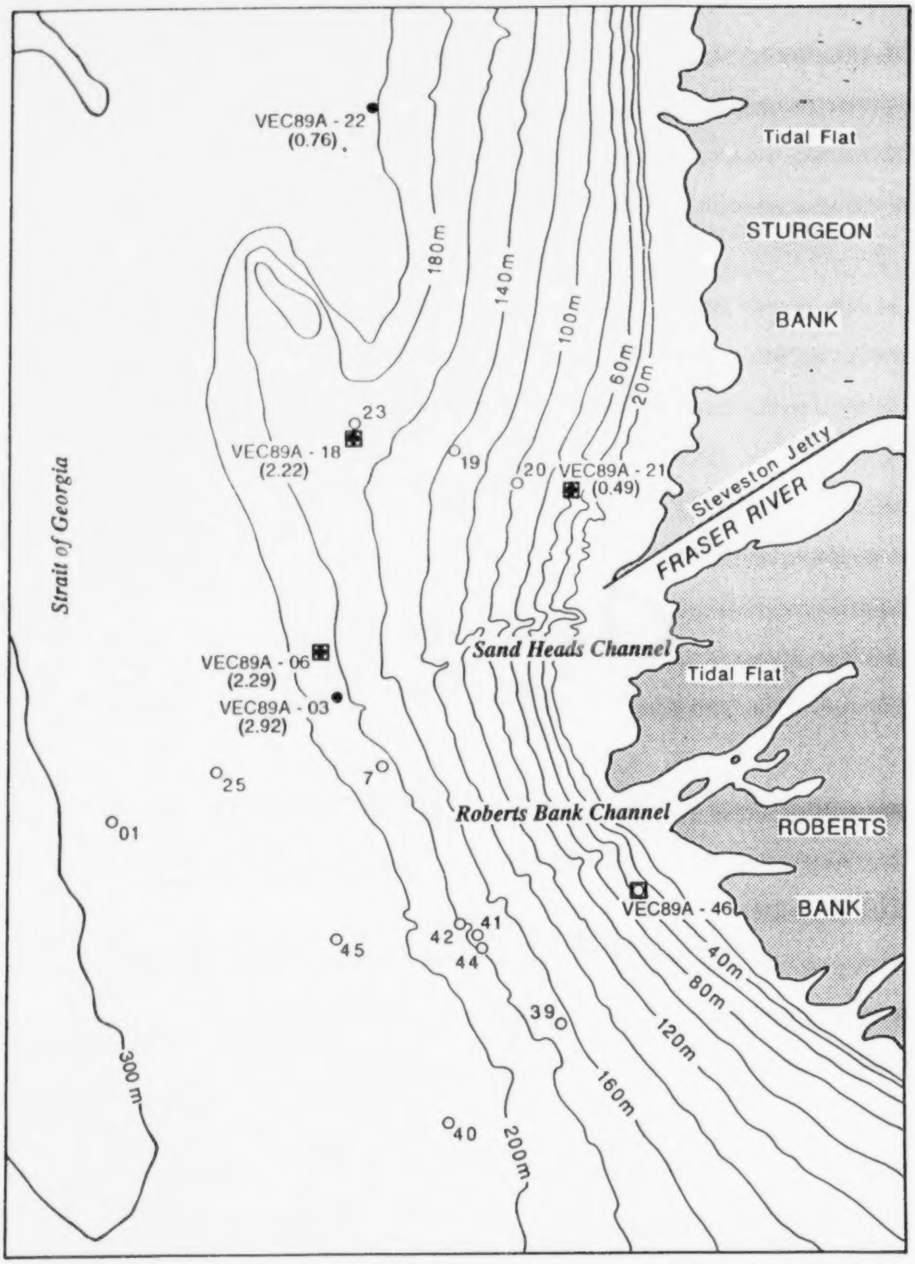
VEC89A - 22
(0.76)
Tidal Flat
STURGEON
BANK
180m
140m
100m
60m
20m
23
VEC89A - 18
(2.22)
19
20
VEC89A - 21
(0.49)
Steveston Jetty
FRASER RIVER
Strait of Georgia
Sand Heads Channel
Tidal Flat
VEC89A - 06
(2.29)
VEC89A - 03
(2.92)
25
7
01
Roberts Bank Channel
ROBERTS
BANK
VEC89A - 46
41
42
44
45
40m
80m
39
120m
160m
300 m
40
200m

Figure 2-2. Detailed bathymetry and piston core locations (open circles) in the study area. Piston core sites with Cs-137 data available are represented by closed circles; open squares represent sites with micropaleontologic data.

Five piston cores collected during this investigation were selected for analysis (Figure 2-2). The sites chosen represent a variety of different subenvironments believed to reflect the probable range of sedimentary processes and sedimentation rates in the area. Sedimentary characteristics of these cores are summarized in Table 2-1. Both the main cores and their trigger cores were logged to ensure that reduction of the section due to coring was minimal.

The cores were sampled continuously across 5-10 cm intervals and analyzed for Cs-137 content. With the exception of core VEC89A-03, all cores were sampled and counted from the sediment-water interface until at least one barren core increment which was not sand-rich was encountered. This ensured that the cores were sampled through the first appearance of Cs-137. This provides a quick and simple method to determine the maximum depth to which Cs-137 is present. As sample intervals exceed annual sedimentation rates, only minimum sediment accumulation rates can be calculated. Cesium analyses for this study were conducted at the Saskatchewan Institute of Pedology, University of Saskatchewan, following the methodology of DeJong *et al.* (1982).

A total of 28 subsamples were taken from 4 piston cores for micopaleontologic analysis (Figure 2-2). Arcellacean and foraminifera populations from the sampled intervals were isolated, identified and counted. The total number of specimens recovered in 19 of the 28 samples collected was too low to place statistical significance on the population counts; however, samples which contain limited populations are of qualitative value where allochthonous specimens from radically different environments are present.

### Sediment Accumulation Rates

Core VEC89A-03 was collected along the flank of the Sand Heads Sea Valley (Figure 2-2). Counting was originally stopped at the 75-80 cm interval because only trace Cs-137 was noted (Figure 2-3A). Based on subsequent experience with coarser grained intervals, the remaining samples were counted; all contained significant concentrations of Cs-137. The

TABLE 2-1. SUMMARY OF SEDIMANTARY CHARACTERISTICS AND MINIMUM SEDIMENT ACCUMULATION RATES

| Piston Core | Length (cm) | Sampling Depth (cm) | Sedimentary Characteristics | Accumulation Rates (cm/yr) |
|---|---|---|---|---|
| VEC89A-03 | 220 | 105 | flank of the Sand Heads channel<br>two coarsening/thickening upward cycles<br>graded fine to medium-grained sands<br>wavy and lenticular bedding, which<br>contains rafted organics and clay-silt interbeds | >2.92 |
| VEC89A-06 | 106 | 90 | 800m north of VEC89A-03<br>poorly defined fining upward cycle<br>primarily massive silty-clay/clayey-silt<br>thin, silty, very fine- to fine-grained sands<br>with graded bases and abrupt tops | 2.29 |
| VEC89A-18 | 381 | 220 | dense, compacted, black clayey-silt<br>few shell fragments and minor disseminated<br>organic matter | 2.22 |
| VEC89A-21 | 423 | 25 | onshore background<br>massive silty clay<br>rare silty laminations | 0.49 |
| VEC89A-22 | 510 | 35 | offshore background<br>structureless silty-clay to clayey silt<br>rare silty laminations<br>minor rafted organic debris | 0.76 |

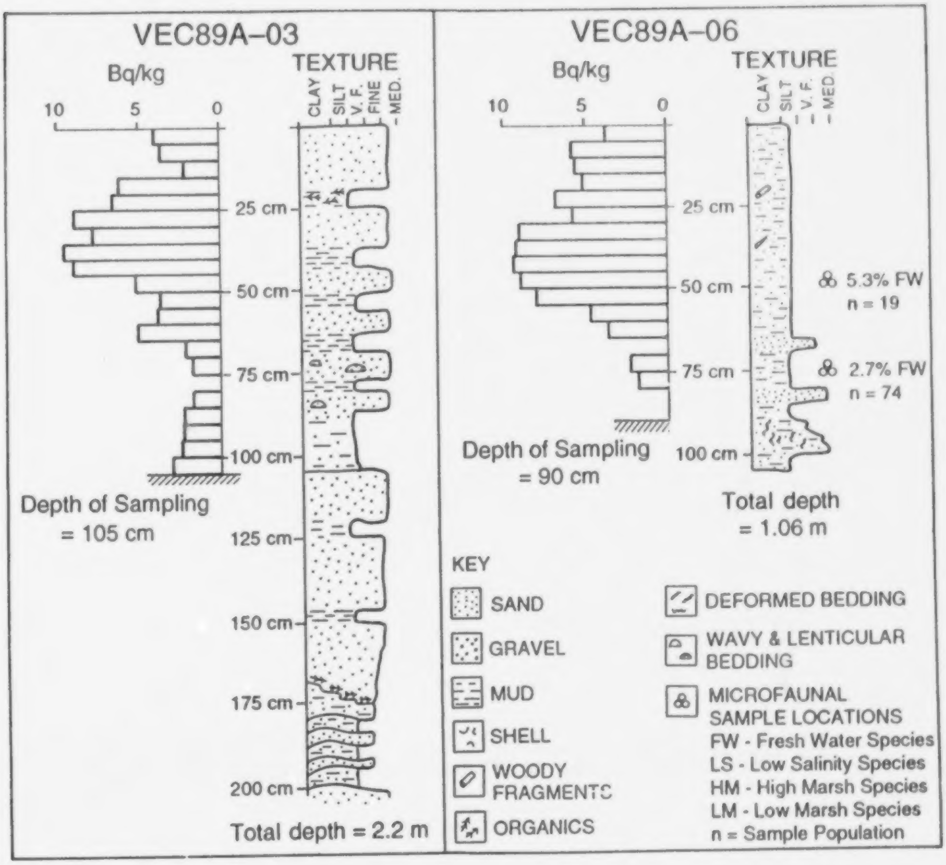

Figure 2-3. Sedimentologic logs and Cs-137 sediment profiles for piston cores VEC89A-03(A) and VEC89A-06(B) with allochthonous micropaleontologic species distribution.

trace interval at 75 to 80 cm has subsequently been found to be composed predominantly of well rounded quartz grains with minor mafic rock fragments and lesser feldspar and mica; clay minerals are virtually absent. Other intervals of similar characteristics commonly show a suppression of Cs-137 values. Accumulation of 105 cm of sediment between 1954 and 1989 requires a minimum sedimentation rate of 2.92 cm/yr.

The base of detectable Cs-137 concentration in core VEC89A-06 occurs at a depth of 80 or 85cm (Figure 2-3B). The reason for this uncertainty is that the barren interval at 80 to 85 cm is predominantly fine quartz sand. Minimum accumulation rate for the interval is 2.29 cm/yr.

Core VEC89A-18 was subsampled for Cs-137 analysis across 10cm intervals (Figure 2-4A). Base of measurable Cs-137 concentration occurs at a depth of 80 cm. Minimum accumulation rate is 2.22 cm/yr. Core VEC89A-21 (Figure 2-4B) represents a typical onshore core for the area. Minimum sedimentation rate for the period 1954 to 1989 is 0.49 cm/yr, and represents the lowest accumulation rate in the study area. Core VEC89A-22 (Figure 2-5) represents a typical offshore core for the area. Minimum sedimentation rate for the period 1954 to 1989 is 0.76 cm/yr.

### Distribution of Micropaleontologic Populations

Foraminiferal fauna recovered from all samples are predominantly species common in neritic depth waters in the Strait of Georgia (Cockbain, 1963), and along the coast of British Columbia (Patterson, 1993). Allochthonous foraminiferal species in the sample set include *Ammobaculites foliaceous*, *Jadammina macrescens*, and *Miliammina fusca*. *J. macrescens* is almost exclusively restricted to the high marsh zone, with only a minor percentage in the low marsh environment; very few get washed out onto the tidal flats of the Fraser delta (Patterson, 1990). *A. foliaceous*, and *M. fusca* are characteristic of the low marsh, and are rarely transported out onto the tidal flat sands.

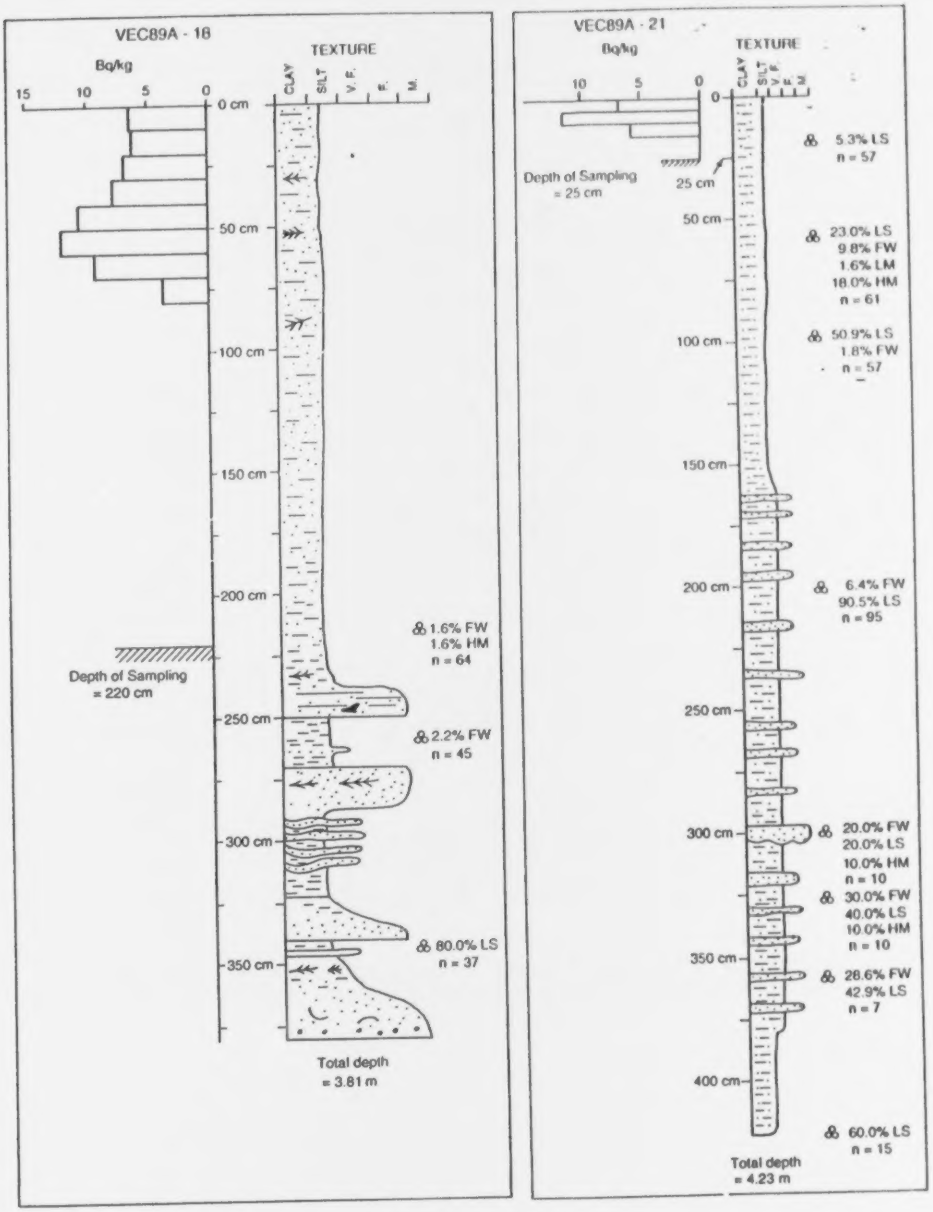
VEC89A - 18
Bq/kg
15
10
5
0
0 cm
50 cm
100 cm
150 cm
200 cm
250 cm
300 cm
350 cm
TEXTURE
CLAY
SILT
V. F.
F.
M.
Depth of Sampling
= 220 cm
1.6% FW
1.6% HM
n = 64
2.2% FW
n = 45
80.0% LS
n = 37
Total depth
= 3.81 m
VEC89A - 21
Bq/kg
10
5
0
0
TEXTURE
CLAY
SILT
V. F.
F.
M.
Depth of Sampling
= 25 cm
25 cm
50 cm
100 cm
150 cm
200 cm
250 cm
300 cm
350 cm
400 cm
5.3% LS
n = 57
23.0% LS
9.8% FW
1.6% LM
18.0% HM
n = 61
50.9% LS
1.8% FW
n = 57
6.4% FW
90.5% LS
n = 95
20.0% FW
20.0% LS
10.0% HM
n = 10
30.0% FW
40.0% LS
10.0% HM
n = 10
28.6% FW
42.9% LS
n = 7
60.0% LS
n = 15
Total depth
= 4.23 m

Figure 2-4. Sedimentologic log for piston cores VEC89A-18(A) and VEC89A-21(B) with Cs-137 sediment profiles and allochthonous micropaleontologic species distribution.

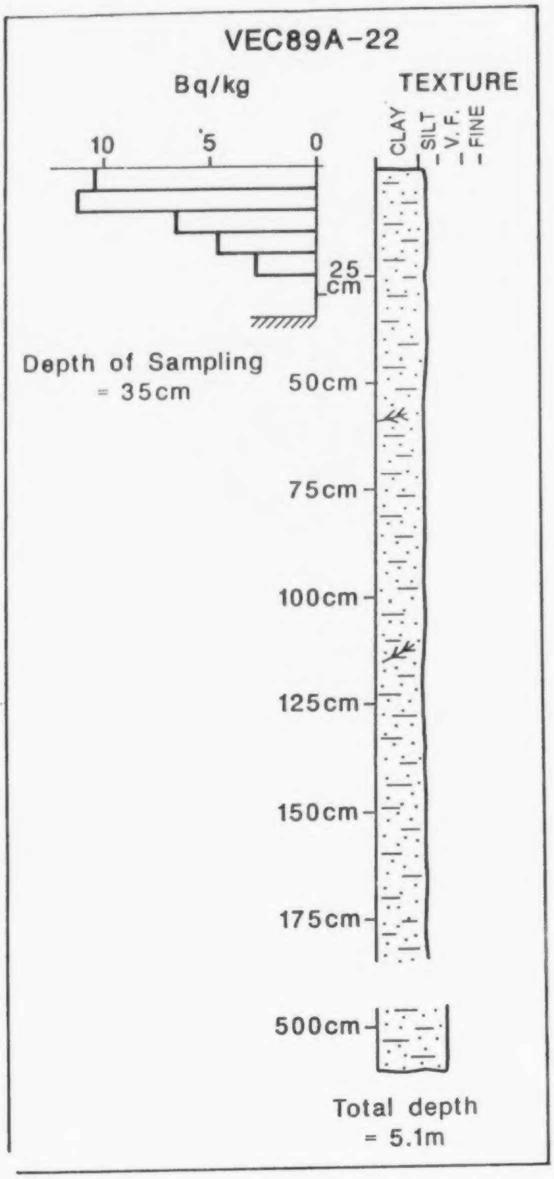

Figure 2-5. Sedimentologic log for piston core VEC89A-22 with Cs-137 sediment profiles.

Arcellaceans are generally restricted to fresh water environments in lakes or above highest tide in salt marshes (Patterson *et al.*, 1985). One exception, *Centropyxis aculeata*, is capable of withstanding very low salinity concentrations on the order of 1 to 2%, and is often found in the highest portions of salt marshes where there is limited incursion of brackish water. *C. arculeata* was encountered in cores VEC89A-21 (Figure 2-4B) and VEC89A-46 (Figure 2-6). Other arcellacean species (*Centropyxis constrictica*, *Difflugia oblonga*, and *Difflugia urceolata*) were found in samples from all cores examined.

## Discussion

Sediment accumulation rates calculated for cores from the Fraser delta foreslope exhibit a wide degree of variation between locations. This trend becomes more pronounced in the vicinity of the Sand Heads Sea Valley. The general spatial pattern evident in the data set shows that accumulation rates increase towards the Sand Heads Sea Valley (Figure 2-7).

Piston core VEC89A-03 represents a thick channelized sequence (Table 2-1) and reflects the highest sedimentation rates in the study area. The Sand Heads Sea Valley is the active depocenter for the Fraser Delta, and greater accumulation rates might therefore be anticipated. The base of Cs-137 accumulation was not sampled in this interval; as a consequence the accumulation rates may be significantly greater than those calculated. The top of the interval may also have been lost due to flowage of unconsolidated sand out of the core barrel, or reduced by erosion. Evidence in support of erosional reduction of the sedimentary record includes the documentation of large scale sediment-gravity flows which have moved up to 1,000,000 $m^3$ of sediment in a single event approximately 5 km up-channel from the core site (McKenna *et al.*, 1992; Kostaschuk *et al.*, 1992).

An increase in Cs-137 concentration in the upper two sample increments of the core is atypical of sediment profiles in the Fraser River delta. This is interpreted to represent the reintroduction of slightly older sediment from upslope via sediment-gravity flow processes.

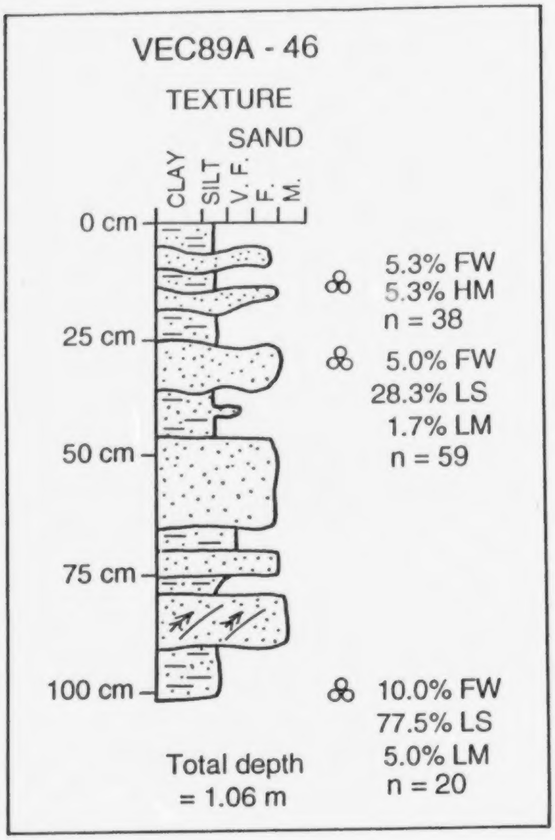
VEC89A - 46
TEXTURE
SAND
CLAY
SILT
V. F.
F.
M.
0 cm
25 cm
50 cm
75 cm
100 cm
5.3% FW
5.3% HM
n = 38
5.0% FW
28.3% LS
1.7% LM
n = 59
10.0% FW
77.5% LS
5.0% LM
n = 20
Total depth
= 1.06 m

Figure 2-6. Sedimentologic log for piston core VEC89A-46 with allochthonous micropaleontologic species distribution.

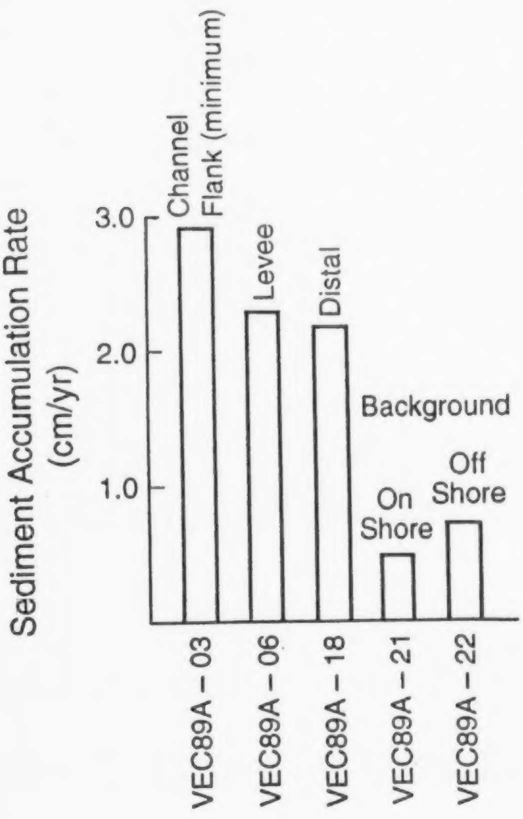

Figure 2-7. Histogram plotting variation in sediment accumulation rates from selected sites on the Fraser River delta through the period 1954 to 1989. Note decrease in sediment accumulation rates laterally away from the Sand Heads channel.

Further evidence in support of the reintroduction and remobilization of sediments in the Fraser River delta area is the presence of abundant allochthonous foraminifera and arcellacean populations in other piston cores collected in this vicinity.

The most significant concentration of arcellaceans encountered is the interval at 200 cm in VEC89A-21. Greater than 90% of the microfaunal population is comprised of *C. aculeata*, and 92 of the 95 specimens collected were arcellaceans. The overwhelming predominance of arcellaceans suggests that samples hosting these specimens moved downslope relatively intact, picking up only a few foraminifera enroute, and cannot be accounted for by simple accidental transport of a few specimens downslope due to tidal current action.

Previous attempts to determine short term rates of vertical accretion in the Fraser delta have been based on comparisons of historic sounding data and hypsographic curves (Johnston, 1921; Matthews and Shepard, 1962; Stewart and Tassone, 1989). Matthews and Shepard (1962) calculated a vertical accretion rate in excess of 33 cm/yr adjacent to the Sand Heads Sea Valley. At the closest sample site to this area, VEC89A-03, the minimum sediment accumulation rate has been calculated to be in excess of 2.9 cm/yr. Although the margin for error using historic sounding data is significant, there has been an appreciable culturally mediated decrease in net bed load discharge at Sand Heads over recent years as a result of increased dredging activity. McLean and Tassone (1991) estimate that the average bed material outflow during the period 1974 to 1983 was less than one third that of the preceding decade. Williams and Roberts (1989) used radiocarbon age dates to estimate the mean vertical accretion rate over the past 2000 years at 0.12 mm/yr.

## Conclusions

Sediment accumulation rates on the Fraser delta foreslope generally increase towards the Sand Heads Sea Valley. This appears to be a function of proximity and suggests that the channel is not only an erosional feature, but a depocenter as well. Accumulation rates along the flank of the channel indicate a minimum accumulation rate of 2.92 cm/yr, but the actual sedimentation rate in this area may be significantly greater.

The identification of large scale slope failures at the mouth of the Sand Heads Sea Valley, increased Cs-137 concentration in the upper sample increments of site VEC89A-03, and presence of abundant allochthonous microfauna in piston cores from the study area all document evidence for remobilization of sediments in the Fraser River delta. Regional distribution patterns and detailed sedimentary characteristics do not appear to be compatible with storm-related erosion and emplacement. These results suggest that slumping and sediment-gravity flow processes may account for the bulk of sedimentation in the Fraser delta foreslope and likely in the subaqueous environments of other deltas. These processes provide a mechanism for sand bypassing of the delta plain and foreslope, and delivery of coarse grained sediment directly to the prodelta environment.

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# CHAPTER 3.

# GRAIN SIZE DISTRIBUTION PATTERNS SUPPORTING SEDIMENT BYPASSING ON THE FRASER RIVER DELTA FORESLOPE, BRITISH COLUMBIA.[2]

## Introduction

A study of grain size distribution patterns on the Roberts Bank portion of the Fraser River delta foreslope has been undertaken as part of an ongoing study into sediment distribution patterns and lithofacies associations on the subaqueous delta foreslope. This study focuses on grain size distribution patterns from 124 samples taken from 22 cores collected during three research cruises aboard the *CSS Vector* (1989), *CSS Parizeau* (1991) and *CSS Tully* (1992).

All cores were first described using a process sedimentologic approach to identify sedimentary facies and genetically related stratigraphic units. Representative samples from each facies were then taken for grain size analysis. The raw grain size data from 135 analyses from an additional 20 piston cores were subsequently provided by the Pacific Geoscience Centre of the Geological Survey of Canada.

### *Geologic Setting*

The Fraser River delta, the largest delta on the west coast of Canada, underlies an area of rapid urban expansion, and is located in one of the most active seismic regimes in Canada. The study area for this project consists of a 150 $km^2$ section of the delta foreslope offshore Sturgeon and Roberts banks (Figure 3-1). Water depths in the main study area range from less than 50 m to greater than 200 m at an average gradient exceeding 3.0°. Concern over the stability of this slope in response to seismic loading has provided the impetus for this and related studies.

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[2] A version of this chapter has been submitted for publication. Evoy, R.W., Moslow, T.F and Luternauer, J.L. *Journal of Coastal Research*.

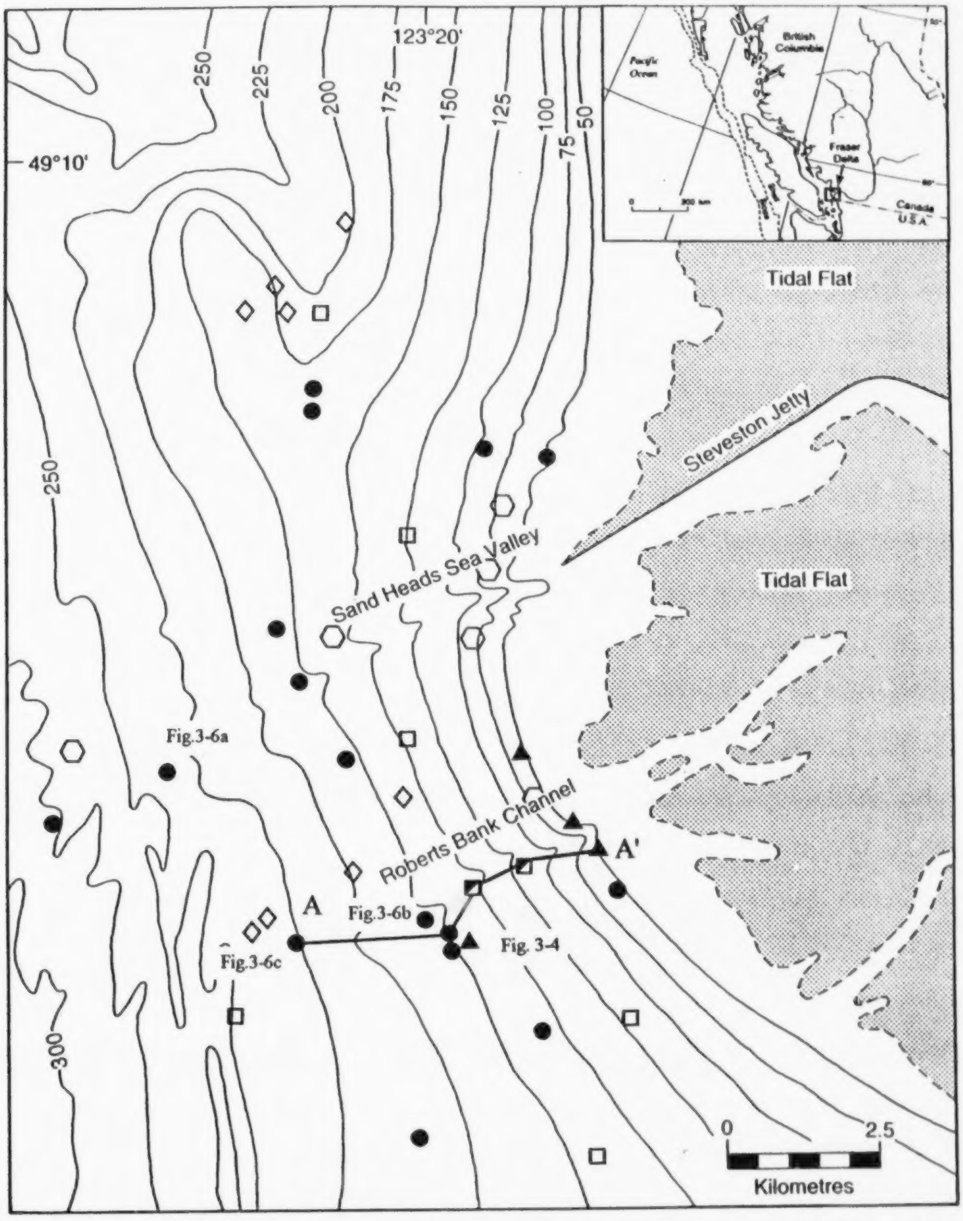
123°20'
49°10'
250
225
200
175
150
125
100
75
50
250
300
British Columbia
Pacific Ocean
Fraser Delta
Canada
U.S.A.
Tidal Flat
Steveston Jetty
Tidal Flat
Sand Heads Sea Valley
Roberts Bank Channel
Fig.3-6a
Fig.3-6b
Fig.3-6c
Fig. 3-4
A
A'
0
2.5
Kilometres

Figure 3-1. Study area location map showing bathymetry and subaqueous channels of the Roberts Bank area, Fraser River delta foreslope. Diamonds represent *Vector* 1983 core sites, circles represent *Vector* 1989 core sites, squares represent *Parizeau* 1991 core sites, hexagons represent *Vector* 1992 core sites, triangles represent *Tully* 1992 core sites. Solid symbols represent core sites subsampled for this study, open symbols represent core sites with grain size data supplied by the Pacific Geoscience Centre of the Geological Survey of Canada.

The distribution of sedimentary facies types across the subaqueous delta foreslope has been documented previously (Evoy *et al.*, 1994); however, textural parameters and the transport mechanisms responsible for sediment bypassing from the tidal flats to the lower delta foreslope are poorly documented. Specifically, the relative significance of turbidity currents and debris flows in sediment transport on the subaqueous portions of the Fraser River delta are the subject of much debate (Hart *et al.*, 1992; Kostaschuk *et al.*, 1992; Evoy *et al.*, 1994). Grain size data are integrated with the results of sedimentary facies analysis to constrain the transport mechanisms.

The delta foreslope is currently bisected by two pronounced bathymetric channels (Figure 3-1). The Sand Heads Sea Valley, off the Main Arm of the Fraser River is the only currently active channel, and most studies of the subaqueous delta have concentrated on sediment transport and failure in the vicinity of the Sand Heads Sea Valley (eg. Kostaschuk *et al.*, 1989; Hart *et al.*, 1992; Kostaschuk *et al.*, 1992; McKenna *et al.*, 1992). The position of the Main Arm of the Fraser River is culturally fixed by the Steveston Jetty and continual dredging of the main navigation channel.

A second submarine channel, the Roberts Bank Channel, is currently inactive and mantled with a thin sediment drape. Although minor coarse sediment input may be sourced by a longshore sandwave migration, the channel has likely not experienced a direct sediment source since upstream channel avulsion circa 1827 (Luternauer and Finn, 1983). As such, the Roberts Bank Channel predates any appreciable anthropogenic mediation and represents the closest approach to a natural setting on the delta foreslope. This study focuses on the immediate vicinity of Roberts Bank, and the Roberts Bank channel and fan system as the most prominent and well developed bathymetric expression of a "natural" channel on the delta foreslope.

## METHODOLOGY

### *Sample Preparation and Analytical Techniques*

Sediment samples representative of all recognized depositional subenvironments present on the subaqueous delta foreslope were collected for grain size analysis. All samples were subdivided into individual particle size class distributions on a mass (dry-weight) basis. The coarser than 4 phi fraction (sand and gravel) was determined by sieve analysis, and the finer than 4 phi fraction (silt and clay) was determined using a Micromeritics SediGraph (5100) Analyzer.

Bulk samples were first dried and dissaggregated prior to initial weighing of the sample. The entire sample was then placed in a set of sieves and agitated on a shaker table for a minimum of 15 minutes per sample. Gravel, sand, and mud (finer than 230 mesh) fractions were all isolated and weighed. The medium sand and finer fractions were all collected in 1 phi increments; the gravel and coarse sand fractions were negligible, and were not further subdivided.

Grain size distribution in the finer than 4 phi fraction (silt and clay) was determined using the 230 mesh split collected from the bulk sample during sieving. Approximately 3 g of dry sediment and 30 ml of 0.05% sodium metaphosphate were added to a beaker and mixed using a magnetic stirrer for 3 minutes. The beaker was then placed in a sonic bath for 1 minute to disperse the clays, and returned to the magnetic stirrer for an additional 3 minutes. Samples were washed from the beaker into the SediGraph mixing chamber using additional 0.05% sodium metaphosphate solution, diluting the sample concentration on the order of 50 percent.

The SediGraph determines particle sizes in the silt and clay ranges in terms of equivalent spherical diameter. This is achieved by means of X-ray absorption of a finely collimated beam, based on particle concentration at decreasing depths through time (Stein, 1985). Minimum sample concentration is not critical to the analysis, provided it is sufficient to reduce the intensity of the transmited X-ray beam by 40 to 60 percent (Singer *et al.*, 1988).

Six samples, with clay contents varying from less than 2% to greater than 40%, were rerun to test for data reproducibility. None of the clay size fractions in these duplicates varied by more than 1.5% of the total sample. Fractions finer than 12 phi were not further subdivided.

### *Statistical Reduction*

Summary grain size statistics, including mean and standard deviation (sorting), have been calculated for all samples (Table 3-1). Both arithmetic and graphic methods were used to calculate these parameters. The moment method is an arithmetic approach, essentially a weighted average as modified by Krumbein and Pettijohn (1938). The resultant values appear to be high (overly fine grained) in comparison to the expected values based on visual inspection of weight percent histograms. Consequently, these parameters were re-calculated utilizing a graphical method based on cumulative percent frequency distribution (Folk and Ward, 1957; Pettijohn *et al.*, 1973), resulting in mean grain sizes that are consistently 1/2 to 3/4 phi coarser than the moment statistics.

Some discrepancy between generated statistics was introduced as a result of calculating moments based on populations that have a pronounced bimodal distribution. A more significant source of error may be the presence of an "open ended distribution" - one in which laboratory limits were placed on the coarsest and finest fractions differentiated. In general, the incomplete data represented by an open-ended frequency distribution restricts the utility of the moment method to characterization of the central part of a distribution only (Griffiths, 1967).

Treatment of the cumulative frequency curve distribution in its entirety necessitates the use of the percentile approach afforded by graphical measures (Inman, 1952). Consequently, graphically generated grain size parameters are presented and utilized in this

Table 3-1. Summary of grain size parameters and sedimentary facies designations.

| Core Name | interval (1) | %sand | %silt | %clay | mean | std. dev. | Facies (2) |
|---|---|---|---|---|---|---|---|
| VEC89A-01 | 0 - 5 | 19.74 | 39.80 | 38.92 | 6.81 | 3.20 | 1 |
| | 573 - 580 | 27.29 | 29.80 | 42.19 | 6.70 | 3.20 | 1 |
| VEC89A-03 | 6 - 12 | 58.33 | 28.84 | 12.75 | 4.41 | 3.25 | 4a |
| | 12 - 15 | 87.86 | 9.56 | 1.21 | 2.81 | 0.94 | 4a |
| | 30 - 31 | 38.08 | 38.33 | 22.35 | 5.40 | 2.75 | 4a |
| | 35 - 40 | 44.37 | 38.99 | 13.66 | 4.70 | 2.49 | 4a |
| | 70 - 72 | 82.94 | 12.85 | 3.14 | 2.85 | 1.22 | 4a |
| | 75 - 80 | 65.41 | 28.96 | 5.36 | 3.90 | 1.88 | 4a |
| | 95 - 97 | 40.59 | 34.82 | 22.76 | 5.10 | 2.81 | 4a |
| | 110 | 92.61 | 5.02 | 1.25 | 2.11 | 1.07 | 4a |
| | 116 | 16.09 | 44.84 | 38.52 | 6.51 | 2.71 | 4a |
| | 125 | 97.44 | * | * | 1.90 | 0.83 | 4a |
| | 145 | 96.56 | * | * | 1.95 | 0.83 | 4a |
| | 170 | 89.97 | 8.10 | 1.54 | 2.10 | 1.45 | 4a |
| | 173 | 59.01 | 27.09 | 12.46 | 4.30 | 2.45 | 4a |
| | 210 | 96.23 | * | * | 1.80 | 0.79 | 4c |
| | 220 | 57.98 | 26.77 | 14.41 | 4.06 | 2.73 | 4a |
| VEC89A-06 | 35 | 32.09 | 40.40 | 27.10 | 5.70 | 2.82 | 1/2 |
| | 66 | 86.85 | * | * | 4.30 | 3.03 | 4b |
| | 100 | 59.11 | 22.28 | 18.02 | 4.30 | 3.15 | 2/3 |
| VEC89A-07 | 285 - 295 | 32.27 | 29.12 | 37.79 | | | 2 |
| | 332 | 34.14 | 27.53 | 38.33 | 6.30 | 3.02 | 2 |
| | 380 - 390 | 26.18 | 37.57 | 34.62 | 6.40 | 3.13 | 1 |
| VEC89A-18 | 50 | 12.37 | 42.94 | 42.59 | 7.16 | 2.96 | 1 |
| | 245 | 76.04 | 19.09 | 3.45 | 3.03 | 1.50 | 4b |
| | 260 | 21.75 | 35.92 | 40.92 | 6.70 | 3.12 | 1 |
| | 330 | 86.28 | 10.65 | 2.15 | 2.55 | 1.27 | 4 |
| | 360 | 96.08 | * | * | 2.10 | 0.90 | 4b?/4a |
| | 375 - 380 | 94.52 | 3.78 | 1.27 | 2.30 | 0.85 | 4b?/4a |
| VEC89A-20 | 295 | 27.53 | 45.66 | 26.16 | 5.80 | 2.50 | 2 |
| | 400 | 95.05 | 3.29 | 1.24 | 2.53 | 0.68 | 4 |
| | 420 | 85.35 | 11.16 | 2.61 | 2.75 | 1.15 | 4 |
| VEC89A-21 | 50 - 55 | 17.66 | 39.67 | 41.61 | 6.66 | 3.13 | 1 |
| | 90 - 95 | 23.23 | 43.45 | 32.17 | 6.43 | 3.04 | 1 |
| | 300 - 305 | 28.39 | 41.66 | 29.29 | 5.50 | 2.78 | 4b |
| | 307 - 310 | 39.37 | 36.36 | 23.04 | 5.35 | 3.01 | 2 |
| VEC89A-23 | 127 | 79.09 | 15.33 | 3.09 | 3.02 | 1.61 | 4b |
| | 150 | 18.34 | 36.79 | 42.46 | 6.90 | 3.12 | 1 |
| | 180 | 89.67 | 7.49 | 2.22 | 2.50 | 1.20 | 4b/4c |
| VEC89A-25 | 15 | 96.41 | * | * | 1.70 | 0.73 | 4c |
| | 70 | 99.52 | * | * | 1.50 | 0.73 | 4c |
| | 130 | 99.46 | * | * | 1.56 | 0.71 | 4c |
| VEC89A-39 | 17 | 50.82 | 27.15 | 21.30 | 4.78 | 2.76 | 2? |
| | 32 | 74.09 | 14.33 | 11.17 | 3.46 | 2.67 | 3 |
| | 70 | 94.49 | 3.64 | 1.60 | 2.23 | 0.87 | 4a |
| | 100 | 98.00 | * | * | 2.01 | 0.79 | 4a |
| | 125 | 84.16 | 8.46 | 6.95 | 2.36 | 1.73 | 4a |
| | basal sand | 93.26 | 4.03 | 2.37 | 2.16 | 1.38 | 4a |
| VEC89A-40 | 20 | 31.11 | 46.29 | 21.76 | 5.60 | 2.50 | 1/2 |
| | 25 | 93.01 | * | * | | | 5 |
| | 30 | 37.56 | 30.77 | 31.20 | 5.80 | 3.13 | 1/2 |
| VEC89A-41 | 20 - 23 | 67.54 | 17.65 | 14.19 | 3.92 | 2.78 | 3 |
| | 60 - 62 | 99.34 | * | * | 2.16 | 0.73 | 4a/4c |
| | 90 | 96.68 | 2.48 | 0.49 | 2.10 | 0.88 | 4a/4c |
| | 120 | 74.52 | 17.35 | 7.44 | 3.20 | 2.35 | 2? |
| | 140 | 98.07 | * | * | 1.86 | 0.77 | 4a |
| VEC89A-42 | 0 - 5 | 60.56 | 24.25 | 13.96 | 4.25 | 2.50 | 1? |
| | 44 - 46 | 92.72 | 5.54 | 0.95 | 2.33 | 0.88 | 4 |
| | 58 - 62 | 74.26 | 14.91 | 9.99 | 3.56 | 2.40 | 4? |
| | 28 - 30 | 69.95 | 20.83 | 7.24 | 3.75 | 2.04 | 2? |
| VEC89A-44 | 15 - 20 | 44.73 | 24.49 | 30.23 | 5.60 | 3.08 | 1 |
| | 25 - 28 | 73.74 | 14.49 | 11.24 | 3.81 | 2.65 | 3 |
| | 28 - 32 | 97.09 | 1.01 | 0.81 | 1.83 | 0.80 | 4c |
| | 50 | 96.94 | * | * | 1.76 | 0.77 | 4c |
| | 100 | 99.14 | * | * | 1.75 | 0.74 | 4c |
| | 150 | 99.37 | * | * | 1.60 | 0.79 | 4c |
| | 200 | 97.90 | 1.57 | 0.40 | 2.08 | 0.74 | 4a/4c |
| | 165 | 65.91 | 18.24 | 15.34 | 4.05 | 2.86 | 2? |
| | 173 | 59.30 | 25.72 | 14.49 | 4.13 | 2.72 | 2? |
| | 254 | 73.83 | 17.98 | 7.54 | 3.40 | 2.20 | 4a? |
| | 259 | 91.55 | 6.23 | 1.66 | 2.43 | 1.05 | 4a |
| | 262 - 265 | 51.45 | 23.64 | 23.98 | 4.80 | 3.01 | 1/2? |
| VEC89A-45 | 10 - 15 | 92.78 | 5.45 | 1.29 | 2.09 | 0.81 | 4a |
| | 45 - 50 | 56.33 | 22.99 | 21.22 | 4.40 | 3.19 | 4a/4b? |
| | 60 - 65 | 89.75 | 6.59 | 3.54 | 2.40 | 1.18 | 4a |
| | 90 - 95 | 87.29 | 8.24 | 3.97 | 2.48 | 1.40 | 4a |
| | 103 - 105 | 61.94 | 18.49 | 18.89 | 4.21 | 3.22 | 3? |
| | 140 | 97.05 | * | * | 2.24 | 0.79 | 4a? |
| | 144 | 78.74 | * | * | * | * | 4a? |
| VEC89A-46 | 20 | 75.36 | 16.73 | 7.07 | 3.52 | 2.01 | 3 |
| | 35A | 85.24 | 9.84 | 4.47 | 2.52 | 1.33 | 4b |
| | 35B | 72.93 | 15.40 | 10.94 | 3.75 | 2.43 | 3 |
| | 60 | 95.39 | * | * | * | * | 4a |
| | 85 | 85.95 | 9.83 | 3.65 | 2.12 | 1.40 | 4a |
| | 95 - 97 | 53.53 | 30.34 | 14.92 | 4.29 | 2.73 | 1 |
| PAR91A-14 | 18 - 20 | 29.37 | 43.17 | 25.34 | 5.80 | 2.75 | 3/4b? |
| | 78 - 80 | 19.39 | 45.95 | 33.95 | 6.50 | 2.90 | 2 |
| | 175 - 177 | 45.45 | 37.55 | 15.97 | 4.50 | 2.80 | 1/2 |
| | 245 - 247 | 23.52 | 37.41 | 35.80 | 6.65 | 3.30 | 1/2 |
| | 300 - 302 | 28.42 | 37.73 | 33.99 | 6.30 | 3.25 | 1 |
| | 390 - 392 | 43.94 | 30.63 | 23.71 | 5.80 | 3.02 | 1 |
| PAR91A-26 | 15 - 17 | 32.59 | 29.79 | 34.06 | 6.50 | 3.30 | 2/3? |
| | 70 - 72 | 30.90 | 27.62 | 36.42 | 6.80 | 3.40 | 1 |
| | 150 - 152 | 35.87 | 29.65 | 32.57 | 6.40 | 3.30 | 1/2 |
| | 198 - 200 | 42.62 | 22.67 | 31.59 | 6.23 | 3.30 | 1/2 |
| | 290 - 292 | 42.73 | 25.00 | 29.51 | 6.15 | 3.30 | 2? |
| | 360 - 362 | 37.21 | 23.14 | 36.79 | 6.50 | 3.40 | 1/2 |
| | 420 - 422 | 43.00 | 23.34 | 30.76 | 6.10 | 3.30 | 2? |
| TUL92A-79 | 30 - 32 | 57.06 | 17.90 | 22.36 | 4.80 | 3.00 | 1/2 |
| | 59 - 61 | 55.06 | 19.86 | 23.06 | 4.83 | 3.07 | 1/2 |
| | 130 - 132 | 43.53 | 26.20 | 29.52 | 5.60 | 3.14 | 1 |
| | 175 - 177 | 96.28 | * | * | 1.70 | 0.78 | 4 |
| | 198 - 200 | 68.30 | 17.21 | 13.14 | 3.88 | 2.90 | 4 |
| | 220 - 222 | 95.99 | * | * | 2.06 | 0.82 | 4 |
| | 250 - 252 | 42.03 | 29.46 | 28.91 | 5.60 | 3.06 | 1 |
| | 335 - 337 | 65.10 | 16.05 | 18.39 | 4.55 | 2.80 | 2? |
| | 375 - 377 | 55.31 | 22.01 | 19.33 | 4.60 | 3.10 | 2/3? |
| | 425 - 427 | 95.57 | * | * | 2.55 | 0.70 | 4b |
| TUL92A-112 | 10 - 12 | 67.55 | 21.59 | 10.16 | 4.06 | 2.10 | 2/3? |
| TUL92A-[illegible] | 15 - 17 | 68.33 | 17.24 | 12.81 | 4.10 | 2.77 | 3 |
| | 45 - 47 | 62.11 | 20.57 | 15.20 | 4.50 | 2.89 | 2 |
| | 80 - 82 | 42.30 | 27.22 | 17.00 | * | * | 1 |
| | 135 - 137 | 50.17 | 28.56 | 19.64 | 4.73 | 2.80 | 1 |
| | 170 - 172 | 53.37 | 27.46 | 18.04 | 4.65 | 2.80 | 1 |
| | 185 | 76.41 | 13.64 | 8.89 | 3.36 | 2.51 | 2/3 |
| | 213 - 215 | 69.14 | 18.15 | 11.53 | 3.75 | 2.84 | 4/4b |
| TUL92A-163 | 18 - 20 | 84.06 | 8.02 | 6.90 | 2.46 | 1.53 | 4b |
| | 43 - 45 | 91.41 | 5.12 | 2.72 | 2.35 | 1.11 | 4 |
| | 65 - 67 | 80.00 | 9.84 | 8.71 | 3.30 | 2.39 | 4 |
| | 71 - 73 | 66.12 | 18.93 | 12.87 | 3.85 | 2.78 | 3? |
| | 92 - 94 | 84.34 | 8.86 | 5.52 | 2.73 | 1.47 | 4 |
| | 133 - 135 | 40.20 | 34.25 | 22.76 | 5.56 | 2.93 | 3 |
| | 163 - 165 | 86.15 | 7.42 | 5.15 | 2.50 | 1.46 | 4 |
| | 187 - 190 | 80.40 | 11.79 | 7.20 | 2.93 | 1.96 | 4 |

| | |
|---|---|
| Note (1) | All intervals in cm below top of core |
| Note (2) | Modified from Evoy et al. 1993_, in press. |
| 1 | silty clay |
| 2 | clayey silt with <10% discrete fine sand laminae |
| 3 | interbedded clayey silt/very fine to medium sand |
| 4a | very fine to medium sand with <10% silty laminae |
| 4b | very fine to fine sand beds <10cm thick |
| 4c | massive fine to medium sand |
| 5 | debris flow |
| * | insufficient silt/clay size sample volume for SediGraph analysis |

study. The spatial trends in grain size parameters remain consistent in either case: the selection of statistical measures of grain size parameters thus has no observable impact on the pattern of grain size distributions in any figures presented herein.

## Results

### *General*

Results of the grain size analysis have been presented in a variety of different fashions to emphasize both spatial and temporal patterns and trends. In addition, specific intervals were selected for the preparation of loose-sediment grain-mount thin sections, SEM analysis, and/or XRD analysis to determine the composition of various grain size fractions. To further simplify comparisons between individual samples, each interval was then classified by its sedimentary facies characteristics according to criteria summarized below (Table 3-2).

Sediment supply at the head of the delta can be estimated from mean annual total sediment load data collected at Mission, British Columbia. Based on 18 years of data, McLean and Tassone (1991) calculated grain size distribution of this load to consist of approximately 35% sand, 50% silt, and 15% clay-sized material.

### *Grain Size Distributions*

Sample textures range from sand to clayey silt (Figure 3-2). Mean grain size ranges from a maximum of 1.5 phi (medium sand) to a minimum of 7.16 phi (very fine silt); sorting varies between 0.68 (moderately well sorted) and 3.40 (poorly sorted). Degree of sorting generally decreases with decreasing mean grain size throughout the medium to very fine sand intervals before flattening in the silt category. There is a slight increase in quality of sorting in the fine to very fine silt classes, with the poorest sorting present in the medium to coarse silts. Local variations in this pattern (eg: VEC89A-06 on Figure 3-3) represent overbank sedimentation laterally adjacent to the channel margins, and reflects interbedded sand and mud laminae below the resolution of sampling.

Table 3-2. Summary of main sedimentary facies characteristics from the subaqueous Fraser River delta. Modified from Evoy et al., 1994.

| Facies Designation | | Lithology | Sedimentary and Bedding Characteristics |
|---|---|---|---|
| Facies | Depositional Process | | |
| 1, 2 | suspension sedimentation | silty clay to clayey silt; <10% silt or v.fine sand as discrete laminations. | massive to plane parallel laminated; rare wavy to lenticular beds; bedded and disseminated organics. |
| 3 | mixed traction/suspension sedimentation | interbedded clayey silt with v.fine/fine sand; silt > sand. | plane parallel laminations; lenticular bedding; contacts gradational, rarely abrupt. |
| 4a | channel fill sands: lateral accretion, vertical aggradation, and slumping. | silty, v.fine to medium sand <10% silt/clay interbeds | massive, wavy or lenticular bedding; normal to inverse grading; convolute laminations, oversteepened bedding; rare load casts; contacts gradational or sharp, thickens/coarsens upwards. |
| 4b | low density turbidity currents | silty v.fine to fine sand in beds <10cm thick | massive, poorly sorted; contacts sharp or gradational; erosive bases. |
| 4c | high density turbidity currents | silty, fine to medium sand | massive, mud rip-up clasts; abrupt contacts. |
| 5 | debris flows | resedimented organics, shell fragments and sand; silt/clay matrix | poorly sorted, chaotic; mud rip-up clasts. |

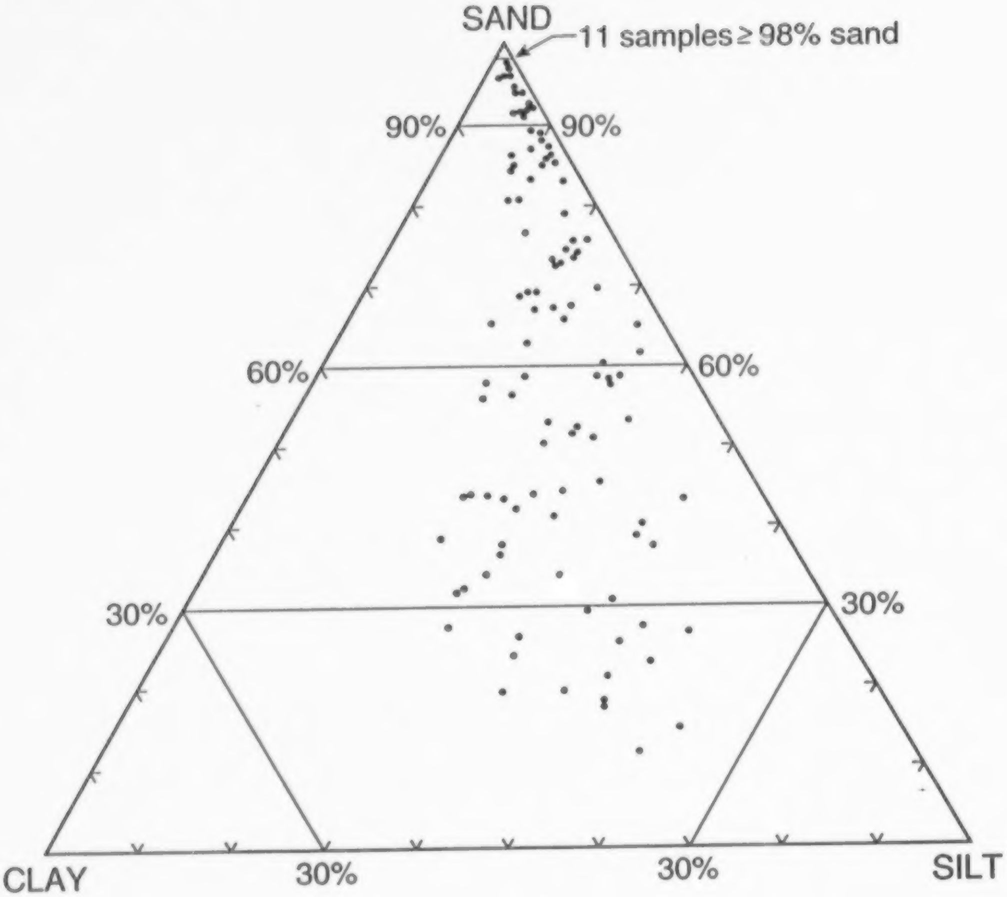

Figure 3-2. Ternary diagram of all samples collected for grain size analyses, with exception of those intervals which contained insufficient sample volumes in the combined silt and clay class intervals for SediGraph analysis. N = 115.

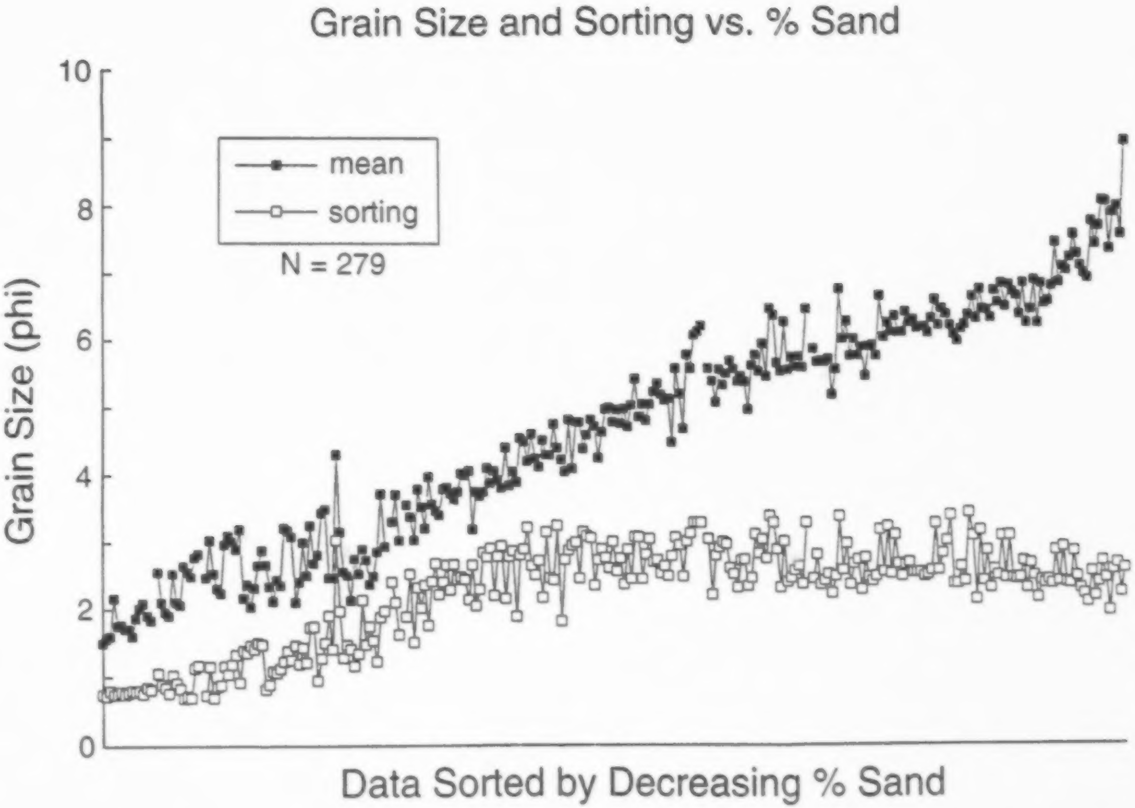

Figure 3-3. Graphical plot of mean grain size versus sorting for the entire population, ordered by total percent mud (silt plus clay). Sorting generally improves with increase in total sand, and with increasing grain size (decreasing phi) throughout the sand interval, and is poorest in the medium silt fraction. Anomaly at VEC89A-06 (66cm) represents overbank flow from the Sand Heads Sea Valley. Closed squares represent mean grain size, open squares represent sorting. Data range from > 99.5% sand to < 12.5%sand as documented on Table 3-1.

Sampling was intended to include all sedimentary facies present on the subaqueous delta, irrespective of individual volume significance. As a result, the entire population is biased towards sand-rich intervals: no attempt can be made to calculate "average" delta grain size parameters.

Representative characteristics of sedimentary facies present on the delta foreslope can be summarized as a general series of increases in depositional energy, preserved traction-related sedimentary structures and percentage sand (Table 3-2). To simplify the recognition and interpretation of patterns, all samples were identified by their facies designation. As anticipated, there is a continuous distribution between Facies 1 through Facies 4 (Figure 3-4). This reflects the increasing hydraulic regime from suspension settling in Facies 1, through mixed suspension settling and variable traction deposition in Facies 2 and 3, to turbidite deposition in Facies 4.

The continuum in grain size distributions between facies is best exemplified by cross-plotting percent sand versus percent mud (silt plus clay), as shown in Figure 3-5. Because of the general absence of gravel-sized material, data were not normalized to 100 percent; the pronounced deflection from the trend at sample VEC89A-40 (25cm) reflects the presence of significant (12.8%) gravel-sized shelly debris and wood fragments in the sole Facies 5 debris flow recovered.

The transitional nature in the distinction between Facies 1 and 2 suggests that this is a subjective differentiation, and is not texturally definable (Figures 3-4 and 3-5); consequently, they are treated as a single unit for presentation purposes. This is consistent with the interpretation of these two facies as representing deposition from suspension, with only modest influence from periodic low-velocity traction currents. The Facies 1 interval underlying the debris flow in VEC89A-40 contains a portion of a fish spine in which the vertebrae remain articulated, suggesting burial by suspension sedimentation under conditions of near complete quiescence. The break between Facies 2 and Facies 3 coincides with the first

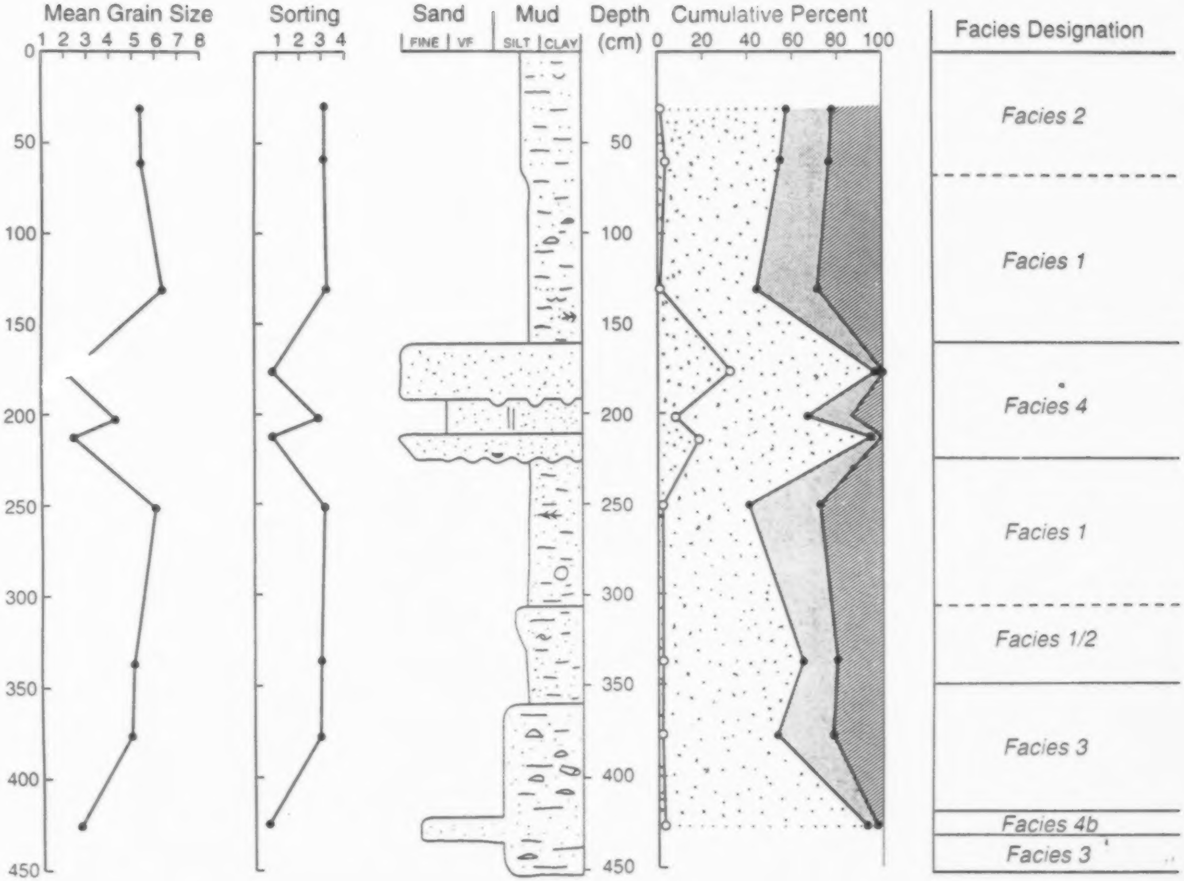

Figure 3-4. Sedimentologic log, textural characteristics and facies designations for piston core TUL92A-79. On cumulative percent distributions, textural classes represent sand (fine stipple), silt (mixed stipple and horizontal lines), and clay (diagonal lines). Open circles represent percent medium sand. See Figure 3-1 for location.

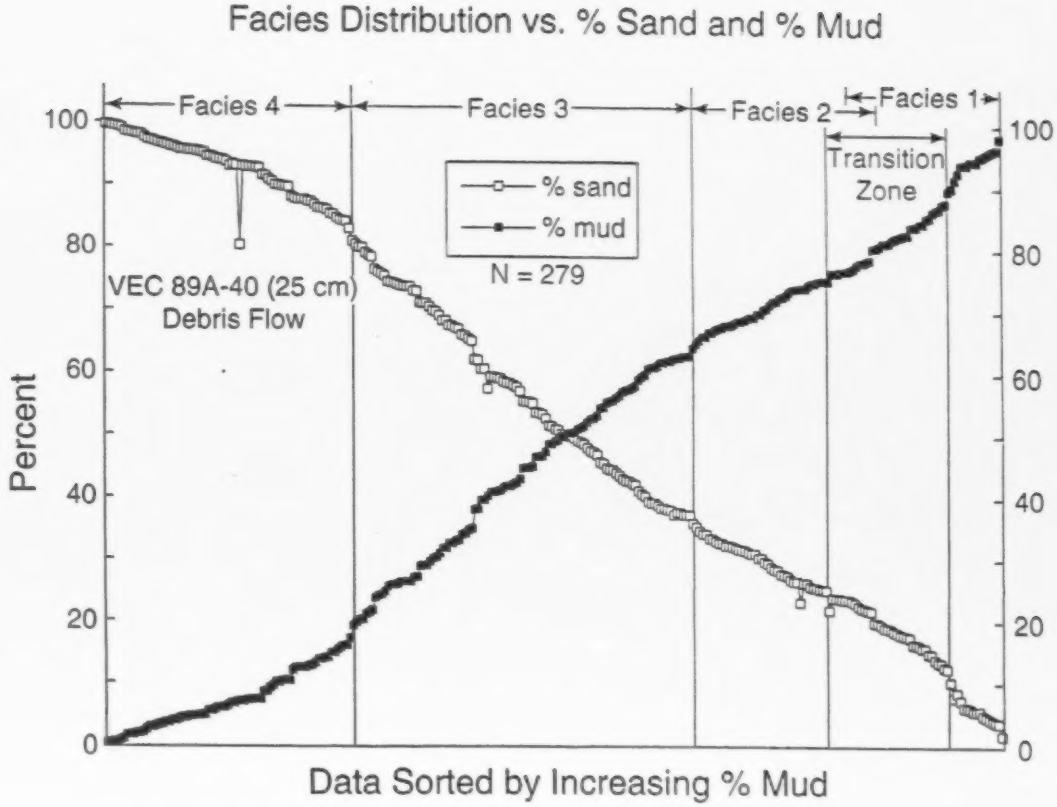

Figure 3-5. Facies distributions as a function of cummulative sand:mud percentages. Note the transitional nature of the change from Facies 1 to Facies 2, and the more pronounced (but still subtle) step between Facies 2, 3 and 4. Sample VEC89A-40 (25cm) represents the sole occurence of Facies 5 debris flow. Closed squares represent percent sand, open squares represent percent mud (silt + clay). Both data sets are presented (N=279), facies designations based on original U of A database (N=124).

appearance of distinct sand beds (very fine- to fine-grained), which are interpreted as reflecting deposition from low density turbidity currents.

*Sand Distribution - Facies 4*

Fifty-five of the 124 samples collected (44%) were taken from sands of Facies 4. These represent the coarsest grained, and best sorted sediments documented in the study. The majority of these samples are associated with the Roberts Bank Channel and its depositional lobe (Table 3-3), and a lesser number are from the lower portion of the Sand Heads Sea Valley and its terminus (Figure 3-6). Only limited sampling was undertaken in the vicinity of the Sand Heads Sea Valley; additional data have subsequently been provided by the Geological Survey of Canada (Figure 3-1).

Facies 4 sands contain approximately 10% mud sized material, with over one-third of these containing less than 4% mud. Facies 4C sands exhibit both the coarsest mean grain size sediment present (~1.8 phi), and the cleanest sands (~1.9% mud). Spatially, most Facies 4 sands are located along the axial trend of the two main channels crossing the foreslope (Figure 3-7), with Facies 4C restricted to the locus of deposition at the base of these channels. The distribution pattern shows that while abundant sand may be supplied to the tidal flats and the channel heads, cross-slope transport of the coarser grain sizes is limited to the main channel systems and the areally greatest sand accumulations are at the base of the delta slope in water depths exceeding 200 metres.

This trend is best illustrated in the combined facies/grain size distribution cross-section presented in Figure 3-8. The upper and middle foreslope are areas of near complete bypassing by the coarser sediment fractions. Furthermore, the depositional lobe deposited at the base of the Roberts Bank channel (VEC89A-45) contains less clay, is better sorted, and is coarser grained than any of its upslope correlative cores (Figure 3-8).

Twenty of the Facies 4 samples identified did not contain sufficient sample volumes

Table 3-3. Grain size distributions, parameters and characteristics for Facies 4 sands in the vicinity of Roberts Bank channel and Sand Heads Sea Valley. Asterix represents samples with insufficient sample volumes in the combined silt and clay sizes for Sedigraph analysis. Key to comments: m - mica flakes, s - shelly debris, w - wood fragments.

| Core Name | Interval | %sand | %mud | %silt | %clay | sand:mud | mean | sorting | comments | Facies | location |
|---|---|---|---|---|---|---|---|---|---|---|---|
| VEC89A-25 | 70 | 99.52 | 0.48 | * | * | 206.81 | 1.50 | 0.73 | m | 4c | Sand Heads Sea Valley |
| VEC89A-25 | 130 | 99.48 | 0.52 | * | * | 193.08 | 1.56 | 0.71 | m/s | 4c | Sand Heads Sea Valley |
| VEC89A-44 | 150 | 99.37 | 0.63 | * | * | 157.37 | 1.60 | 0.79 | s | 4c | Roberts Bank Channel |
| VEC89A-41 | 60 - 62 | 99.34 | 0.66 | * | * | 149.79 | 2.16 | 0.73 | w/m/s | 4a/4c | Roberts Bank Channel |
| VEC89A-44 | 100 | 99.14 | 0.86 | * | * | 114.65 | 1.75 | 0.74 |  | 4c | Roberts Bank Channel |
| VEC89A-44 | 50 | 98.94 | 1.06 | * | * | 92.95 | 1.76 | 0.77 | s | 4c | Roberts Bank Channel |
| VEC89A-25 | 15 | 98.41 | 1.59 | * | * | 62.08 | 1.70 | 0.73 | m | 4c | Sand Heads Sea Valley |
| TUL92A-79 | 175 - 177 | 98.28 | 1.72 | * | * | 57.14 | 1.70 | 0.76 | m | 4 | Roberts Bank Channel |
| VEC89A-03 | 210 | 98.23 | 1.77 | * | * | 55.44 | 1.60 | 0.79 | w | 4c | Sand Heads Sea Valley |
| VEC89A-41 | 140 | 98.07 | 1.93 | * | * | 50.90 | 1.86 | 0.77 | w/m | 4a | Roberts Bank Channel |
| VEC89A-44 | 200 | 97.90 | 2.10 | 1.57 | 0.40 | 49.60 | 2.08 | 0.74 | m/s | 4a/4c | Roberts Bank Channel |
| VEC89A-03 | 125 | 97.44 | 2.56 | * | * | 38.04 | 1.90 | 0.83 | w/m | 4a | Sand Heads Sea Valley |
| VEC89A-44 | 28 - 32 | 97.09 | 2.91 | 1.91 | 0.81 | 35.71 | 1.83 | 0.80 |  | 4c | Roberts Bank Channel |
| VEC89A-45 | 140 | 97.05 | 2.95 | * | * | 32.90 | 2.24 | 0.79 |  | 4a? | Roberts Bank Fan |
| VEC89A-41 | 90 | 96.68 | 3.32 | 2.48 | 0.49 | 32.57 | 2.10 | 0.88 | w/m | 4a/4c | Roberts Bank Channel |
| VEC89A-03 | 145 | 96.56 | 3.44 | * | * | 28.09 | 1.95 | 0.83 | w | 4a | Sand Heads Sea Valley |
| TUL92A-79 | 220 - 222 | 95.99 | 4.01 | * | * | 23.94 | 2.06 | 0.82 | m/w | 4 | Roberts Bank Channel |
| TUL92A-79 | 425 - 427 | 95.57 | 4.43 | * | * | 21.57 | 2.55 | 0.70 | m/w/s | 4b | Roberts Bank Channel |
| VEC89A-42 | 44 - 46 | 92.72 | 7.28 | 5.54 | 0.95 | 14.28 | 2.33 | 0.88 | m | 4 | Roberts Bank Channel |
| VEC89A-45 | 10 - 15 | 92.78 | 7.22 | 5.45 | 1.26 | 13.83 | 2.66 | 0.81 |  | 4a | Roberts Bank Fan |
| VEC89A-03 | 110 | 92.61 | 7.39 | 5.62 | 1.25 | 13.48 | 2.11 | 1.07 | w | 4a | Sand Heads Sea Valley |
| TUL92A-163 | 43 - 45 | 91.41 | 8.59 | 5.12 | 2.72 | 11.66 | 2.35 | 1.11 | m | 4 | Roberts Bank Channel |
| VEC89A-44 | 259 | 91.55 | 8.45 | 6.23 | 1.66 | 11.60 | 2.43 | 1.05 | w | 4a | Roberts Bank Channel |
| VEC89A-03 | 170 | 89.97 | 10.03 | 8.10 | 1.54 | 9.33 | 2.10 | 1.45 | w | 4a | Sand Heads Sea Valley |
| VEC89A-45 | 60 - 65 | 89.75 | 10.25 | 6.58 | 3.54 | 8.87 | 2.40 | 1.18 |  | 4a | Roberts Bank Fan |
| VEC89A-03 | 12 - 15 | 87.66 | 12.34 | 9.56 | 1.21 | 8.14 | 2.81 | 0.94 | w/m | 4a | Sand Heads Sea Valley |
| VEC89A-45 | 90 - 95 | 87.28 | 12.72 | 8.24 | 3.97 | 7.15 | 2.46 | 1.40 |  | 4a | Roberts Bank Fan |
| TUL92A-163 | 163 - 165 | 86.15 | 13.85 | 7.42 | 5.15 | 6.85 | 2.50 | 1.46 | m/w | 4 | Roberts Bank Channel |
| TUL92A-163 | 92 - 94 | 84.34 | 15.66 | 8.88 | 5.52 | 5.86 | 2.73 | 1.47 | m/w | 4 | Roberts Bank Channel |
| TUL92A-163 | 18 - 20 | 84.06 | 15.94 | 8.02 | 6.60 | 5.75 | 2.48 | 1.53 | m | 4b | Roberts Bank Channel |
| VEC89A-03 | 70 - 72 | 82.94 | 17.06 | 12.85 | 3.14 | 5.19 | 2.85 | 1.22 | w/m | 4a | Sand Heads Sea Valley |
| TUL92A-163 | 65 - 67 | 80.00 | 20.00 | 9.84 | 8.71 | 4.31 | 3.30 | 2.39 | m | 4 | Roberts Bank Channel |
| TUL92A-163 | 197 - 199 | 80.40 | 19.60 | 11.76 | 7.20 | 4.24 | 2.93 | 1.96 | m/w/s | 4 | Roberts Bank Channel |
| VEC89A-45 | 144 | 78.74 | 21.26 | * | * | 3.70 | * | * |  | 4a? | Roberts Bank Fan |
| VEC89A-42 | 58 - 62 | 74.26 | 25.74 | 14.91 | 9.99 | 2.98 | 3.56 | 2.40 | w/m | 4? | Roberts Bank Channel |
| VEC89A-44 | 254 | 73.83 | 26.17 | 17.98 | 7.54 | 2.89 | 3.40 | 2.20 | w | 4a? | Roberts Bank Channel |
| TUL92A-162 | 213 - 215 | 69.14 | 30.86 | 18.15 | 11.53 | 2.33 | 3.75 | 2.84 | m/w | 4/4b | Roberts Bank Channel |
| TUL92A-79 | 198 - 200 | 68.30 | 31.70 | 17.21 | 13.14 | 2.25 | 3.88 | 2.90 | m | 4 | Roberts Bank Channel |
| VEC89A-03 | 75 - 80 | 65.41 | 34.59 | 26.98 | 5.36 | 2.02 | 3.90 | 1.88 | w | 4a | Sand Heads Sea Valley |

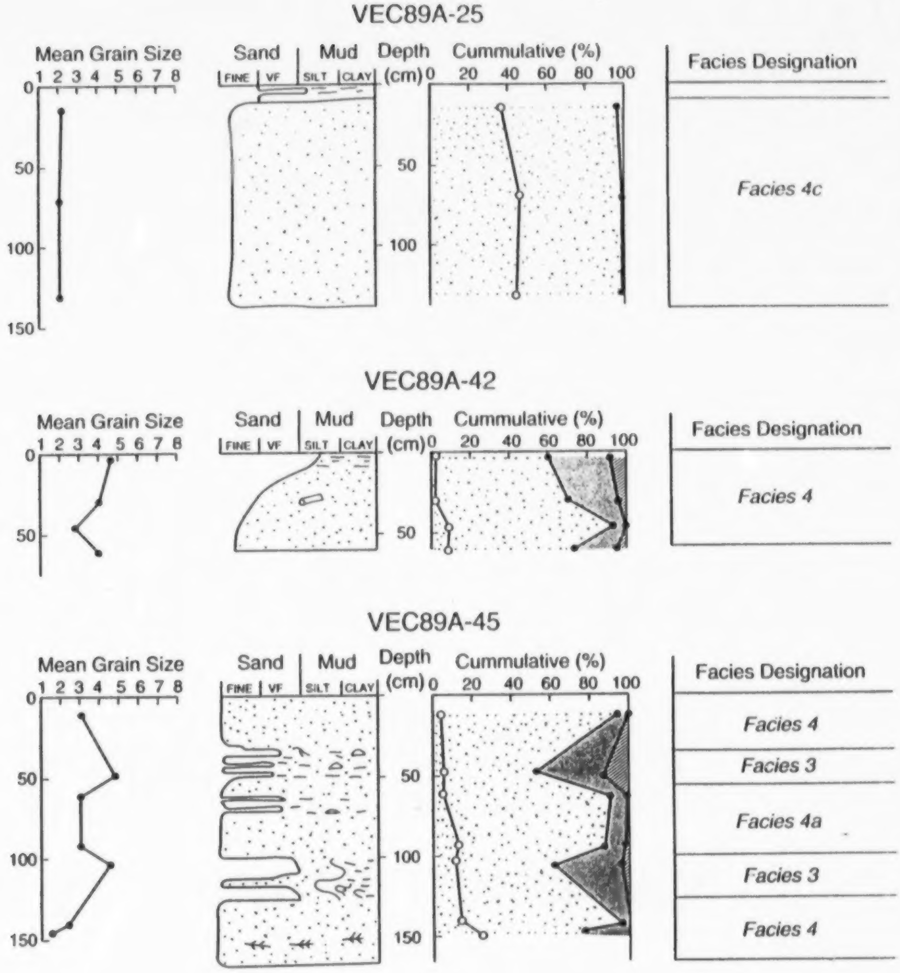

Figure 3-6. Sedimentologic log, textural characteristics and facies designations for piston cores VEC89A-25 (a), VEC89A-42 (b) and VEC 89A-45(c). Cumulative percent distribution legend as in Figure 3-4, see Figure 3-1 for location.

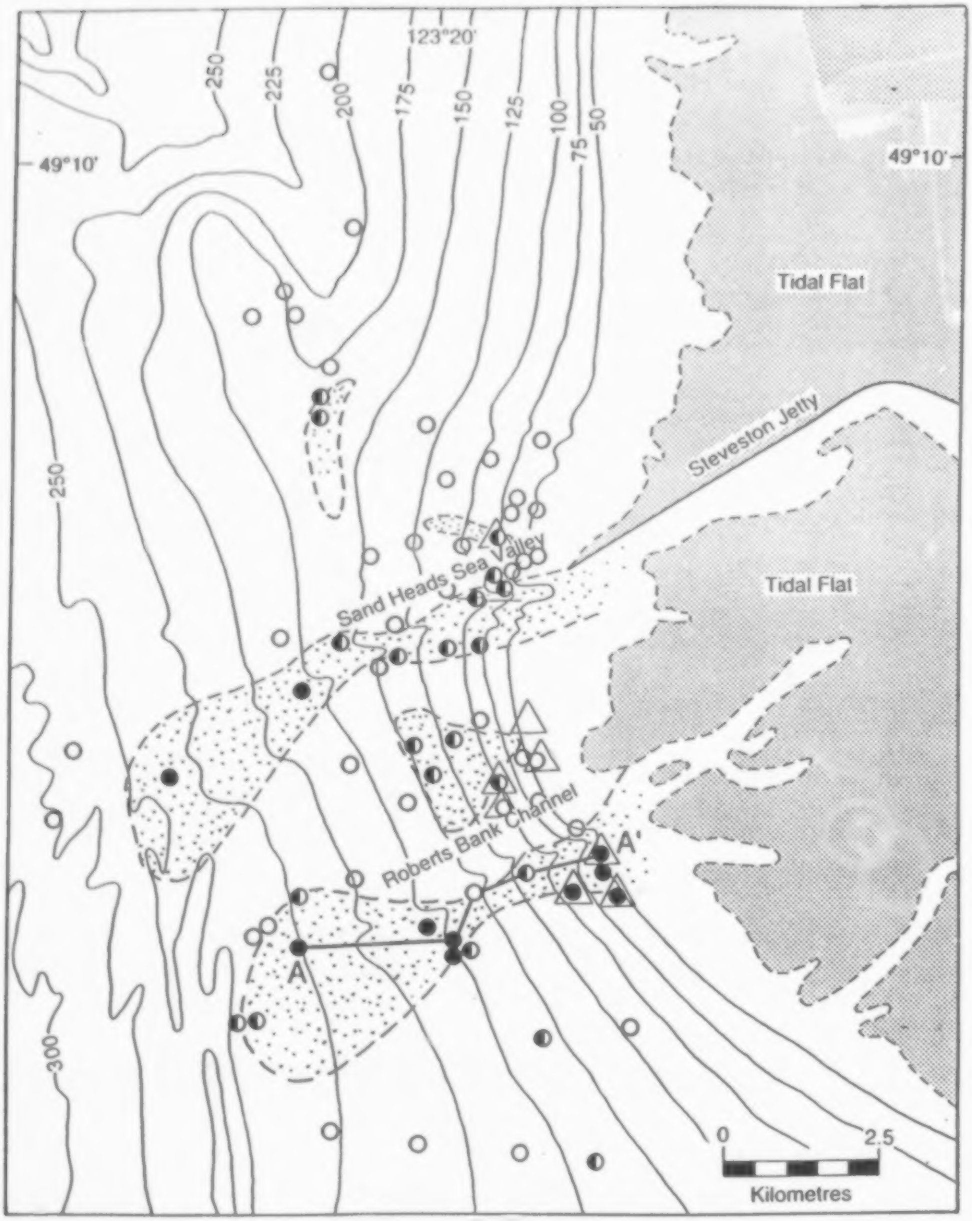
123°20'
250
225
200
175
150
125
100
75
50
49°10'
49°10'
Tidal Flat
Steveston Jetty
Tidal Flat
Sand Heads Sea Valley
Roberts Bank Channel
250
300
A
A'
0
2.5
Kilometres

Figure 3-7. Plan view of facies distributions across the study area, showing major facies components for each core site. Solid circles represent Facies 4, half-filled circles represent minor Facies 4 within an assemblage of predominatly Facies 1 and 2. Triangles represent Facies 3. Outlines of Facies 4 assemblage highlights the degree of bypassing of the foreslope by coarser sediments. Section A-A', along the axial trend of the Roberts Bank channel/fan system, is shown in Figure 3-8.

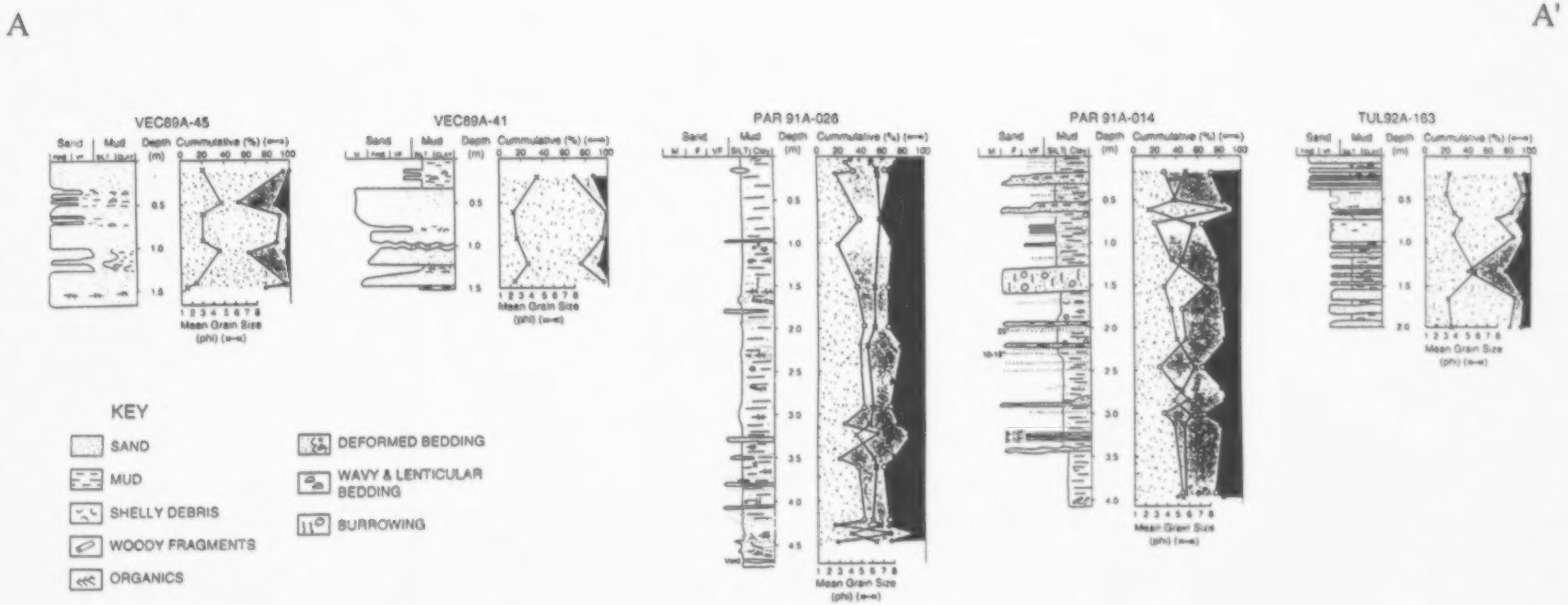
A
A'
VEC89A-45
VEC89A-41
PAR 91A-026
PAR 91A-014
TUL92A-163
Sand
Mud
Depth (m)
Cummulative (%)
0 20 40 60 80 100
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
1 2 3 4 5 6 7 8
Mean Grain Size (phi)
KEY
SAND
MUD
SHELLY DEBRIS
WOODY FRAGMENTS
ORGANICS
DEFORMED BEDDING
WAVY & LENTICULAR BEDDING
BURROWING

Figure 3-8. Dip oriented cross section showing variation in facies and grain size distribution patterns along the trend of the Roberts Bank channel. While abundant sand sized material is supplied to the channel head, the bulk of the channel across the foreslope is sand-poor. Mean grain size in the depositional lobe at the channel base is actually greater than the average mean grain size at the channel head suggesting a preferential bypassing of the coarsest sand fraction present.

in the mud size fraction for Sedigraph analyses, with the majority of these samples (15) containing less than 5% total mud content. Clay to silt ratio in the remaining 35 samples averages 0.357. Since clay to silt ratio decreases with increasing sand to silt ratio (Figure 3-9), the clay to silt ratio can be used to estimate maximum clay contents in the remaining samples, as shown on Table 3-3.

Additional analyses were undertaken to determine the nature and composition of the less than 4 micron (clay sized) fraction. Selected samples containing fines populations varying from less than 2% combined silt plus clay size fractions, to greater than 40% clay size material, were identified and prepared for SEM analysis. Results show that a significant proportion of the clay size fraction in Facies 4 sands (visually estimated at >> 50%), consists of extremely fine siliciclastic debris including quartzose fragments, feldspar shards, and shattered diatoms (Figure 3-10a).

### *Implications for Sediment-Gravity Flow Processes*

The Roberts Bank Channel data afford an opportunity to test competing hypotheses regarding the rheological behaviour of the sediment gravity flows responsible for sediment transport and deposition on the lower Fraser River delta foreslope, and to constrain the mechanisms responsible for channel maintainance and, presumably, initiation and entrenchment. Hart *et al.* (1992) have argued that the Sand Heads Sea Valley and, by inference, other channels on the Fraser River delta foreslope, form as a result of debris flows originating high on the upper slope. Others present arguments that both the Sand Heads Sea Valley (Kostaschuk *et al.*, 1992) and Roberts Bank Channel (Evoy *et al.*, 1994) are maintained by mass wasting and sediment transport and deposition from turbidity currents.

Cohesive debris flows, as used by Hart *et al.* (1992) require at least 5% clay *minerals* in the interstitial fluid to provide cohesive strength. Many of the samples analysed, including all samples with mean grain sizes coarser than fine sand, do not contain this volume of fine sediment even in the combined silt + clay *textural* fractions (Figure 3-3).

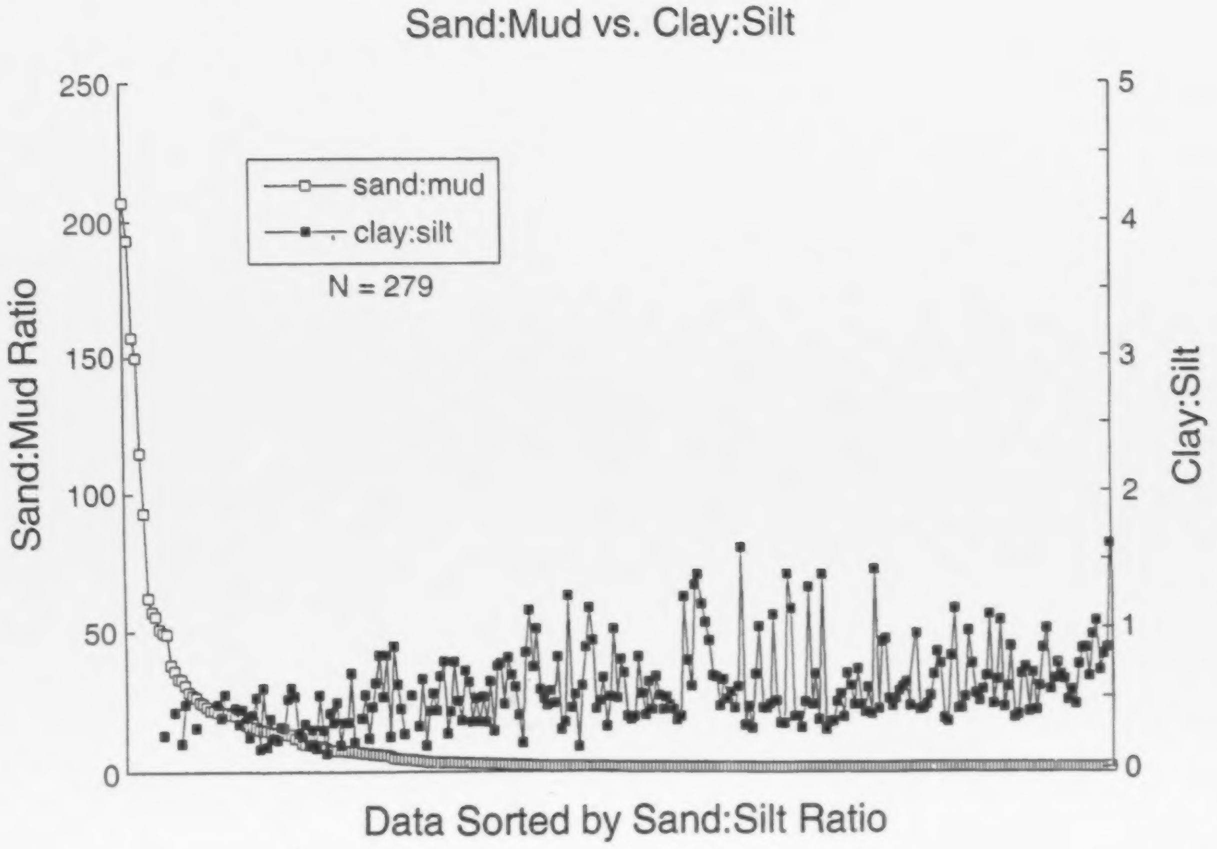

Figure 3-9. Variation in sand:mud and clay:silt ratios in the data set. A slight increase in clay:silt ratio is evident with decreasing sand:mud ratio. N=279.

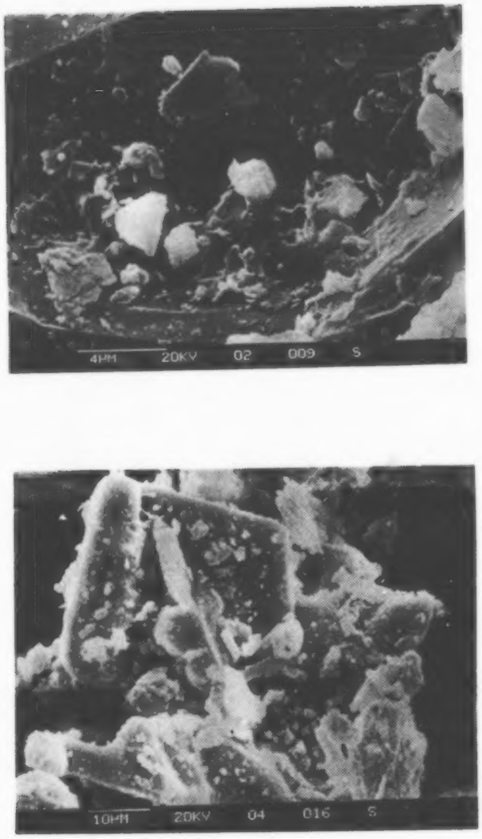

Figure 3-10. SEM photographs of finer than 4 phi (combined silt and clay) fraction from depositional lobe at the mouth of the Roberts Bank Channel, and the terminus of the Sand Heads Sea Valley. Scale bar equals 4 microns (textural clay size). The clay size fraction is composed primarily of shards of feldspar, quartz and diatoms with minor mineralogic clay and trace pyrite. Most clays present are finer than 0.5 microns.

(a) Piston core VEC89A-45, from 10 to 15cm.

(b) Piston core VEC-89A-25, at 15cm.

A significant proportion of the clay size fraction in Facies 4 sands consists of siliciclastic debris including quartz, feldspar and broken diatom fragments. This very fine clastic detritus is estimated to constitute at least 50% of the clay-sized fraction. Mineralogic clays appear to be restricted to a portion of the finer than 2 micron fraction, with most being detrital clays on the submicron scale (Figures 3-10a and 3-10b). This includes samples collected from the terminus of both the Roberts Bank Channel and the Sand Heads Sea Valley, as well as in, or proximal to, the channels themselves.

Facies 4C sands typically contain less than 1% clay size material, and are estimated to contain less than 0.5% clay minerals. Hampton (1975) has estimated that a debris flow strong enough to carry fine sand requires 4% clay in the matrix, which represents approximately 2.3% clay in the final deposit. This calculation is based on the assumption of pure Kaolin clays; the presence of other clay mineral species would be expected increase the matrix competence (Hampton, 1970). Even using a more modest limit of 2% clay for the amount of clay minerals required to provide cohesive strength (lower limit of Middleton and Hampton, 1976), many Facies 4 sands - and all Facies 4C - contain insufficient clay mineral contents to have exhibited cohesive strength during transport (Figure 3-6).

## Discussion

The grain size data presented on Table 3-3, and SEM analyses of the composition of the fines fraction include data from both major channels on the Fraser River delta foreslope. These grain size data appear to be in agreement with those presented by Kostaschuk *et al.* (1992) from inferred turbidites in the thalweg of the Snad Heads Sea Valley. This suggests that turbidity currents play a significant, and probably dominant role in the formation and maintainance of submarine channels on the Fraser River delta foreslope.

While debris flows may also be assumed to be a significant element in the mass transfer of sediment from the subaeriel delta into deep water, the degree to which they are active is poorly constrained in the Fraser River delta. Much of the data cited to support recent debris flows are based on: (1) the documentation of large scale failures in the vicinity of Sand Heads; (2) on surface morphology in areas that have not been successfully cored; and (3) on the absence of recognizable sedimentary structures in massive appearing sands (Hart *et al.*, 1992). As previously stated, the position of the Sand Heads Sea Valley has been anthropogenically fixed and modified by dredging and jetty construction, and is not representative of the historic delta. The presence of massive appearing sand intervals as a quick bed is common in many turbidites, and should be expected to be exaggerated by coring-induced liquifaction.

The mechanism of failure at Sand Heads has been interpreted as retrogressive slope failure (McKenna *et al.*, 1992), probably due to rapid deposition and large tidal draw-down at the river mouth (Kostaschuk *et al.*, 1989). Experimental studies of grain flows in similar environmental settings (Dinger and Anima, 1989) confirm Lowe's (1976; 1982) assertion that this type of cohesionless debris flow can not exceed approximately 5cm in thickness. McKenna *et al.* (1992) argue that failure at Sand Heads results from liquifaction, which then generates a turbidity current. The transformation of liquified flows into turbidity currents via flow acceleration has been postulated previously, based on theoretical considerations (Middleton and Hampton, 1976; Lowe, 1982).

## Conclusions

Samples collected from the Fraser River delta foreslope range in texture from sands to clayey silt. Mean grain size ranges between medium sand (1.5 phi) to very fine silt (7.16 phi); sorting varies from moderately well to poorly sorted. The incomplete data represented by an open-ended frequency distribution restricts the utility of the moment method in the characterization of full spectrum grain size data. Treatment of the frequency curve distribution in its entirety necessitates the use of the percentile approach afforded by graphical measures.

There is a continuous distribution between Facies 1 through Facies 4, reflecting increasing hydraulic regime from suspension settling in Facies 1, to turbidite deposition in Facies 4. Facies 4 sands represent the coarsest grained, and best sorted sediments documented in the study. The majority of these are associated with the Roberts Bank Channel, its' depositional lobe, and the lower portion of the Sand Heads Sea Valley.

The mechanism of failure at Sand Heads and Roberts Bank channel is interpreted as retrogressive slope failure. The resultant liquified flows transform into turbidity currents via flow acceleration, resulting in sediment bypassing of the upper and middle foreslope, and deposition as turbidite lobes at the base of the lower foreslope. Debris flows may also be assumed to be a significant element in the mass transfer of sediment from the delta mouth to deep water; however, the degree to which they are active is poorly constrained in the Fraser delta. Cohesive debris flows (*cf* Postma, 1986) require a minimum 5% clay minerals in the interstitial fluid to provide cohesive strength. Even using a more modest limit of 2% clay for the amount of clay required to provide cohesive strength, few Facies 4 sands contain sufficient clay to have exhibited cohesive strength during transport.

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# CHAPTER 4.

# ORIGIN AND VARIABILITY OF SEDIMENTARY FACIES OF THE FRASER RIVER DELTA FORESLOPE, BRITISH COLUMBIA.[3]

## Introduction

The Fraser River delta is a sand rich, mixed tidal-fluvial dominated delta prograding into water depths in excess of 200 m in Georgia Strait. The delta plain consists of a series of tidal flats with an average slope of less than 0.1°. The subaqueous foreslope extends further seaward at an average slope of 1.5°, and is cut by a number of broad "sea valleys" hundreds of metres wide and up to 10 m in relief (Kostaschuk *et al.*, 1992a). These channels debouch onto the basin floor as a series of sand-rich depositional lobes in approximately 200 to 250 m water depth (Moslow *et al.*, 1991).

The Fraser River transports sand and mud to the delta via strongly seasonal fluvial discharge (Kostaschuk *et al.*, 1992b). The estuary experiences large tidal draw down and the delta exists within one of the most active seismic regimes in Canada. The area is also protected from excessive storm-generated waves by the limited fetch across Georgia Strait. As a consequence, the Fraser River delta constitutes an exceptional natural laboratory for the study of sediment stability and transport mechanisms in an actively prograding delta with large tides, seismic loading and differential rates of sand deposition. The unique geographic setting, with relatively coarse-grained clastic sediments being introduced directly into deep water, may also serve as a useful analogue to lowstand (shelf-edge) deltas.

This study documents sediment distribution patterns in the Fraser River delta foreslope, as determined from piston cores and 3.5 kHz seismic survey data, and focuses on facies associations and deposition of sands on the subaqueous delta slope.

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[3] A version of this chapter has been published. Evoy, R.W., Moslow, T.F., Kostschuk, R.A. and Luternauer, J.L., 1994. *Marine Geology*. 118:49-60.

## Study Area and Methodology

### *Geologic Setting*

The Fraser River delta is the largest and most important delta on Canada's Pacific coast. The Fraser River drains approximately 250,000 $km^2$ of mountainous terrain with peak discharge during the snowmelt freshet in late spring and early summer (Milliman, 1980). Within the Fraser River estuary, a pronounced tidal influence is superimposed on the fluvial regime with semi-diurnal tides at the river mouth approaching 5 m (Kostaschuk *et al.*, 1992b). Tidal range within the estuary decreases upstream and with increasing discharge (Ages and Woolard, 1976), and in conjunction with fluvial discharge produces a pronounced salt-wedge which strongly affects local sedimentation rates and mechanics (Kostaschuk *et al.*, 1992b).

The seaward margin of the Fraser River delta consists of a series of broad tidal flats, up to 9 km wide, with average slopes of less than 0.1°. The subaqueous delta slope extends a further 5 to 10 km seaward at an average slope of 1.5° (Clague *et al.*, 1991). Within the study area, water depths range from less than 50 m to greater than 200 m over a 3.0 km horizontal distance, at an average gradient of 3.0°. Locally, slopes exceed 6° (Hart *et al.*, 1992a), with maximum slope angles as high as 20°.

### *Data and Methods*

Eighteen piston cores and approximately 160 kilometres of 3.5 kHz seismic profiles were collected from the study area during the July 1989 cruise of the *CSS Vector* across the Fraser River delta foreslope. Investigations focussed on the southern half of Sturgeon Bank and the northern half of Roberts Bank (Figure 4-1). Core sites were selected to construct a series of transects documenting along-slope facies variability across channels and depositional lobes, and to constrain across shelf variability from shallow to deep water. Target selection in the vicinity of the Sand Heads Sea Valley (Kostaschuk *et al.*, 1992a) was limited by the constraints of substrate composition and surface currents. All cores were described using a process sedimentologic approach (Siemers and Tillman, 1981) in which sedimentary processes and facies are used to delineate genetically related stratigraphic units. Five sedimentary facies

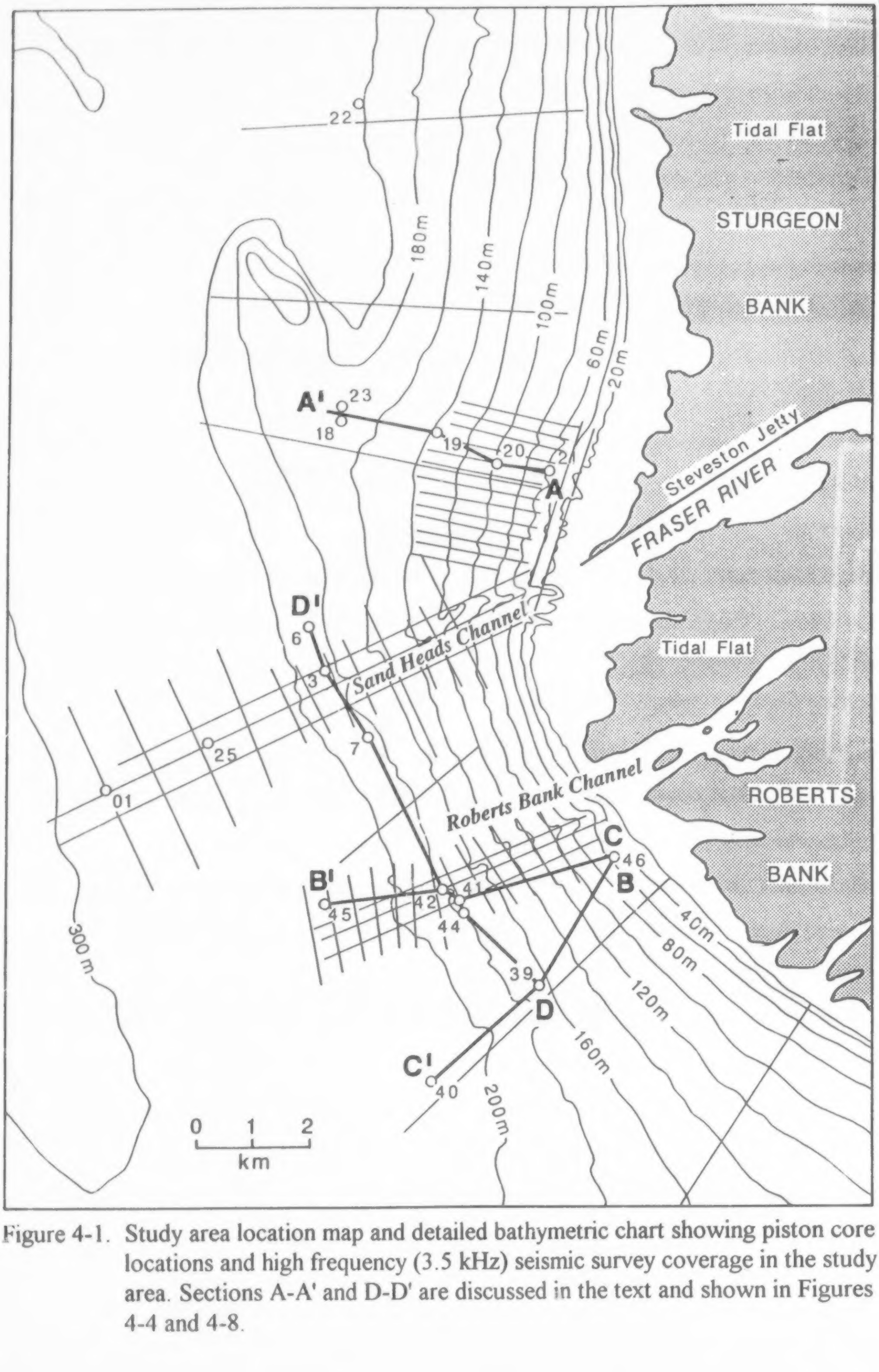
Tidal Flat
STURGEON
BANK
Steveston Jetty
FRASER RIVER
Tidal Flat
ROBERTS
BANK
Sand Heads Channel
Roberts Bank Channel
180m
140m
100m
60m
20m
40m
80m
120m
160m
200m
300m
A'
A
B'
B
C'
C
D'
D
22
23
18
19
20
21
6
3
7
25
01
45
42
41
44
39
46
40
0
1
2
km

Figure 4-1. Study area location map and detailed bathymetric chart showing piston core locations and high frequency (3.5 kHz) seismic survey coverage in the study area. Sections A-A' and D-D' are discussed in the text and shown in Figures 4-4 and 4-8.

were recognized, and one was further divided into three subfacies. Facies characteristics and distributions are summarized in Table 4-1, and are shown schematically on Figure 4-2.

Selected half-slab intervals were subsequently x-radiographed to test for fine-scale structure in massive clayey-silt units, and to look for evidence of bioturbation. Specific intervals were also subsampled for micropaleontologic analysis, textural/mineralogic analyses, and Cs-137 analysis. Results from this latter are presented elsewhere (Moslow *et al.*, 1993; Evoy *et al.*, 1993).

### Facies Characteristics

#### *Facies 1: Massive silty clay*

Facies 1 is a silty clay which is water saturated near the sediment-water interface, but dense and compacted elsewhere. A minor organic component is present consisting of rafted and disseminated plant material. The unit is black on fresh surfaces but readily oxidizes to an olive green colour upon retrieval of the core.

This facies is generally massive and internally structureless, with only rare parallel laminations (Figure 4-2). It is the most common sedimentary facies in the study area, especially in the more distal portion of the delta slope and areas that are not subject to active sedimentation. The depositional process is inferred to be simple gravitational settling from suspension in an area of restricted clastic input and extremely low current velocities.

#### *Facies 2: Silty clay/clayey silt with rare silt laminae*

Facies 2 is composed of massive silty clay to clayey silt with rare parallel silt laminations. This unit is dense, compacted and remains cohesive after dehydration. Variable contents of disseminated rafted and laminated organic material are present. Rare scaphopod and pelecypod shell fragments and weak bioturbation were noted. Burrows consist of a low diversity, low density assemblage of *Skolithos* and *Paleophycus*.

TABLE 4-1: SUMMARY OF SEDIMENTARY FACIES CHARACTERISTICS

| FACIES | TEXTURE/LITHOLOGY | SEDIMENTARY STRUCTURES | BEDDING CHARACTERISTICS | DEPOSITIONAL PROCESSES |
|---|---|---|---|---|
| 1 | silty clay with minor disseminated organics. | rare plane parallel laminations;<br>weakly burrowed. | frequently water saturated at top of core. | suspension settling. |
| 2 | silty clay to clay silt;<br><10% silt/very fine sand laminations;<br>disseminated organics. | rare parallel silt laminae;<br>wavy to lenticular bedding. | dense, compacted. | suspension settling and low-velocity traction currents. |
| 3 | clayey silt with silty, very fine-to medium sand interbeds. | plane parallel laminations;<br>lenticular bedding. | contacts generally gradational, rarely abrupt. | suspension settling with low-density turbidity currents. |
| 4a | silty very fine-to medium-grained sand;<br><10% silt/clay interbeds. | massive, or wavy to lenticular;<br>convolute bedding;<br>normal or inverse grading;<br>minor load casts. | contacts sharp or gradational;<br>oversteepened laminations;<br>thickens/coarsens upwards. | channels:<br>lateral accretion, vertical aggradation and slumping. |
| 4b | silty, very fine-to fine-grained sand;<br>poorly sorted. | massive;<br>erosive(?) base. | contacts sharp or gradational;<br>beds <10 cm thick. | turbidity current |
| 4c | silty, fine-to medium-grained sand. | massive appearing; | abrupt contacts.<br>rare rip-up clasts. | high-density turbidity current |
| 5 | resedimented organics, shell fragments;<br>very fine-to medium sand;<br>silt/clay matrix; poorly sorted. | poorly sorted;<br>mud rip-up clasts. | chaotic. | debris flow or slump. |

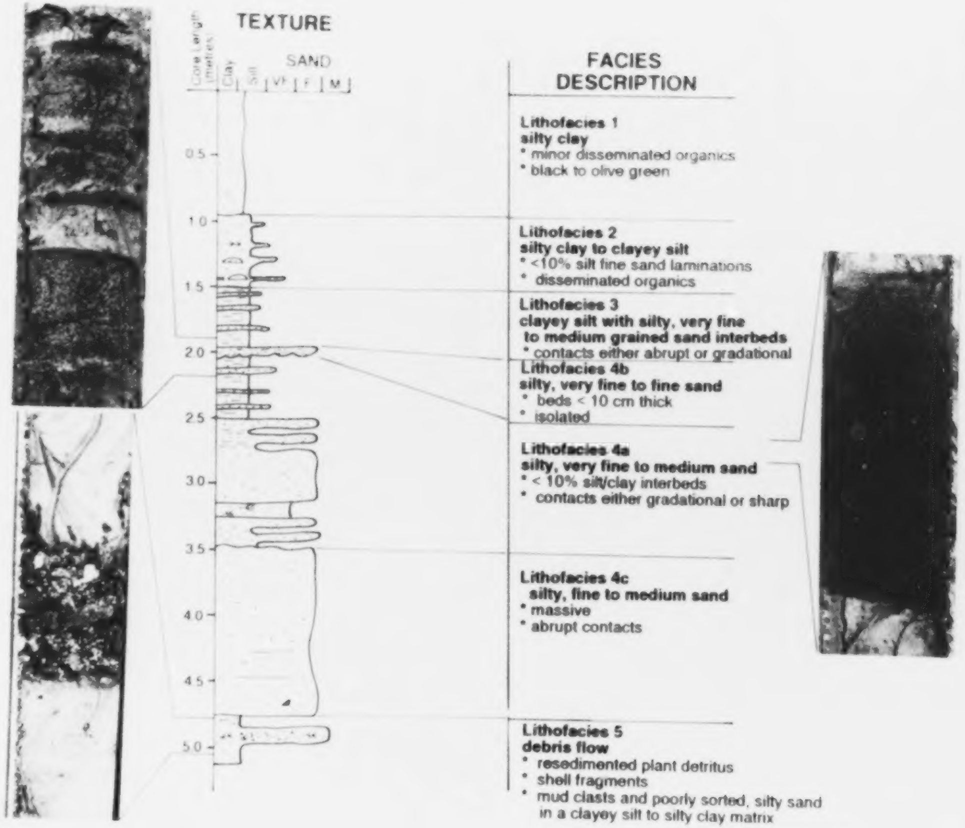
TEXTURE
Core Length (metres)
Clay
Silt
SAND
VF
F
M
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
FACIES DESCRIPTION
Lithofacies 1
silty clay
* minor disseminated organics
* black to olive green
Lithofacies 2
silty clay to clayey silt
* <10% silt fine sand laminations
* disseminated organics
Lithofacies 3
clayey silt with silty, very fine to medium grained sand interbeds
* contacts either abrupt or gradational
Lithofacies 4b
silty, very fine to fine sand
* beds < 10 cm thick
* isolated
Lithofacies 4a
silty, very fine to medium sand
* < 10% silt/clay interbeds
* contacts either gradational or sharp
Lithofacies 4c
silty, fine to medium sand
* massive
* abrupt contacts
Lithofacies 5
debris flow
* resedimented plant detritus
* shell fragments
* mud clasts and poorly sorted, silty sand in a clayey silt to silty clay matrix

Figure 4-2. Composite vertical sedimentary sequence documenting facies types and characteristics in the Fraser River delta foreslope based on a summary of piston core observations. See Table 4-1 for additional details of sedimentary characteristics.

The entire facies contains less than 10% silt and/or very fine sand laminae (Figure 4-2) but locally may consist of up to 15 to 20% of these coarser grain sizes. Silt laminae exhibit plane parallel laminations with individual laminae typically less than 5 mm in width. Fine-grained sand lenses locally exhibit wavy to lenticular bedding. Depositional processes are interpreted as suspension settling of clays, combined with silt laminae deposited directly from the entrained layer of dilute, low density turbidity currents.

This facies is the second most common facies recognized in the study area and represents part of a gradational spectrum with Facies 1. Combined, these two facies total just under 70% of all sediment recovered. The predominance of these two facies may in part be an artifact of recovery. Piston core techniques typically produce their best recoveries in silts and clays, and are less effective in penetrating sand sized material.

### *Facies 3: Interbedded clayey silt and very fine sand*

Sedimentary Facies 3 is a massive clayey silt unit containing 25% to 50% interbedded clean silt and very fine-grained sand beds. Silt beds are less than a few cm thick and consist of plane parallel laminations. Sand lenses are silty and are typically preserved as 2 to 3 cm thick lenticular beds which contain significant concentrations of detrital organic material.

Where no sand is present, this facies varies from Facies 2 only in total silt content. Intrafacies contacts between Facies 2 and 3 are generally gradational, but may be sharp. Facies 3 is a relatively minor constituent in the study area, and is gradational with the coarser members of sedimentary Facies 2 (Figure 4-2).

Depositional mechanisms are inferred to be a combination of suspension sedimentation and deposition from the tail of low density turbidity currents. This is compatible with the restricted recovery of this facies from unchannelized environments in the upper to middle delta foreslope. All cored intervals in which this facies was noted are also contain thin turbiditic sand lenses (Facies 4b).

*Facies 4: Silty, very fine-to medium sand*

Sedimentary Facies 4 includes a variety of silty, very fine-to medium-grained sand units with less than 10% discrete, thin, clay or silt interbeds (Figure 4-2, Table 4-1). Three subfacies are recognized on the basis of individual sand bed thicknesses and geometry, and the presence or absence of silty-clay interbeds.

Facies 4a are sand-rich units with up to 10% silty-clay content. Individual silty-clay beds are less than 5 cm thick. Bed contacts may be either sharp or gradational in nature, and locally show some evidence of loading. Bedding may be either massive, or wavy to lenticular. Internal structures within the sand units include normal and inverse grading, and local parallel laminations marked by silty-clay and/or concentrations of rafted organic material. Soft sediment deformation occurs locally and includes both oversteepened laminations and rare convolute bedding. Sand beds are frequently poorly sorted, immature lithic sands with high matrix and organic contents. The matrix is primarily composed of very fine silt sized quartz fragments and diatom tests.

Vertical stacking is cyclic, and consists of both fining-upwards and well developed thickening and coarsening upwards sequences. This reflects a variety of depositional processes including subaqueous channel migration, avulsion and abandonment. Facies 4a is the predominant sand unit recognized in the study.

Facies 4b consists of very fine-to fine-grained silty sands, in isolated beds up to 10 cm in thickness. Sorting is poor, and beds are generally massive. Contacts may be either sharp or gradational. This facies is usually found as restricted units within sedimentary Facies 1 and 2. The Facies 4b sands are not in equilibrium with the Facies 1 and 2 silts and clays, and their abrupt contacts suggest an erosive component in the flow. Facies 4b is interpreted as deposition from unconfined turbidity currents within an environment dominated by suspension sedimentation.

Facies 4c consists of massive, fine-to medium sand beds greater than 1 m thick. Only two intervals of this facies were recognized in the piston cores, and both exhibit sharp upper contacts. The basal contact was only penetrated in a single core, and was an abrupt contact marked by a concentration of rip-up clasts. Facies 4c is interpreted as deposition from high-density turbidity currents.

*Facies 5: Disorganized, chaotic beds*

Facies 5 consists of a single interval of large wood fragments, shell fragments and clay clasts in a muddy matrix. The unit exhibits chaotic bedding and is internally massive. Bed contacts consist of an erosive base with an abrupt top (Figure 4-2). This facies may represent either a debris flow or a slump, and was found near the top of a thick interval of Facies 1 in 210 m of water at the base of the foreslope.

## Facies Relationships and Origin

### *Sturgeon Bank Slope*

Sturgeon Bank is a 75 km$^2$ depositional lobe north of the Steveston Jetty and the Sand Heads Sea Valley (Figure 4-1). The foreslope off Sturgeon Bank has not had a direct sediment source since the earliest 1900's (Clague *et al.*, 1983), and has been isolated from the Main Arm of the Fraser River since the completion of the Steveston Jetty. The area is underlain by subparallel continuous reflectors which drape relief on the underlying sediments (Hart *et al.*, 1992b). Based on sediment accumulation rates of 2.22 cm/yr (Moslow *et al.*, 1991), and accumulation of 3 to 8 m of undisturbed sediment, the slope appears to have been stable for the past 150 to 400 years (Hart *et al.*, 1992b).

Cross section A-A' was constructed across the delta slope on Sturgeon Bank immediately north of the Sand Heads Sea Valley (Figure 4-3). The upper foreslope here is dissected by numerous small-scale gullies which appear to be inactive, and have likely been dormant since completion of Steveston Jetty.

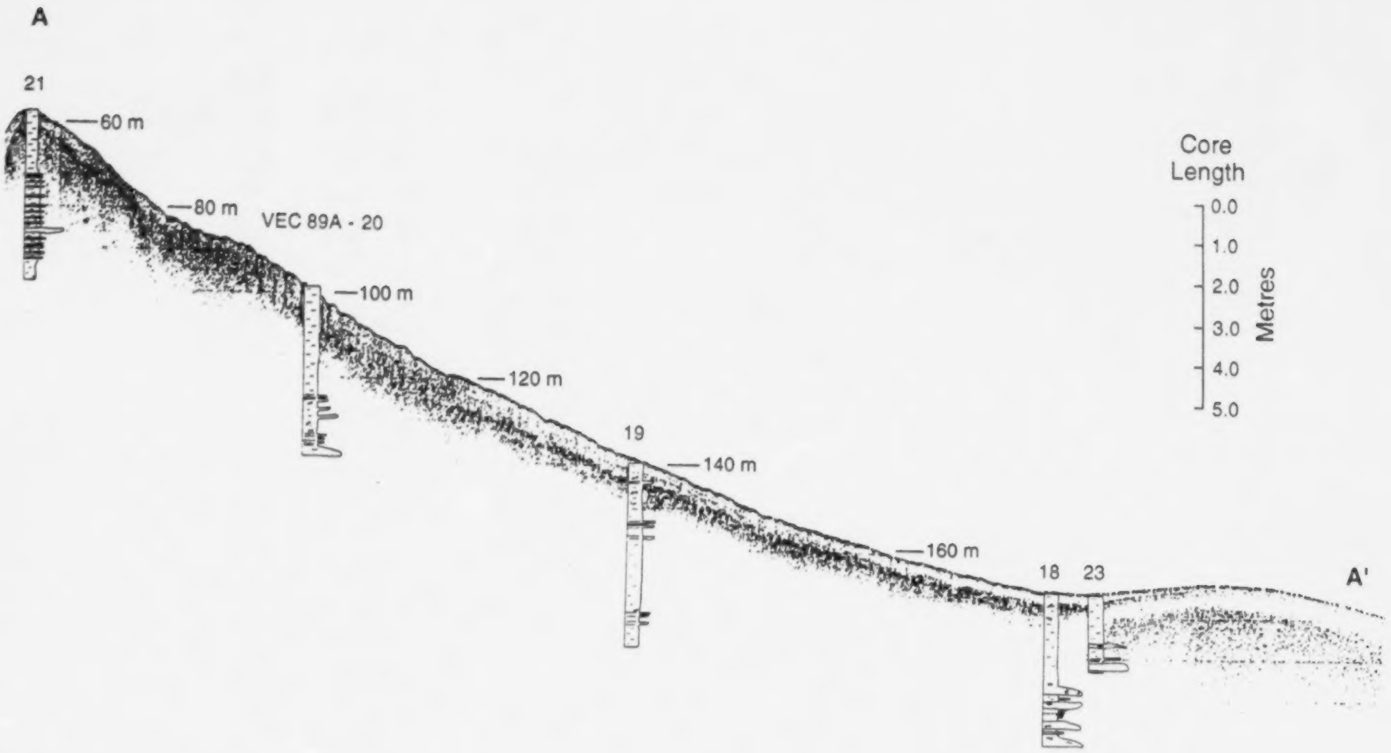
A
21
60 m
80 m
VEC 89A - 20
100 m
120 m
19
140 m
160 m
18
23
A'
Core Length
0.0
1.0
2.0
3.0
4.0
5.0
Metres

Figure 4-3. Sturgeon Bank dip-oriented cross-section A-A', projected onto a 3.5 kHz seismic survey line. Irregular surface bathymetry reflects surface creep and local small-scale slumping. Positive feature at the base of the slope represents the influence of a Pleistocence glacial ridge. Average seafloor slope between cores 21 and 18 is approximately 2°. See figure 4-1 for location.

Piston core VEC89A-21, from an interchannel environment, consists of a thick unit of Facies 3 within Facies 1 (Figure 4-3). The Facies 3 assemblage may represent a relict gully levee. One thin (7 cm) sandy interval consisting of poorly sorted immature sand with a muddy matrix, abrupt contacts and loaded base (Facies 4b) was noted at a depth of 3.0 m and may correlate to other sediment gravity flow deposits in cores immediately down slope along this section.

Piston cores VEC89A-19 and VEC89A-20 represent sedimentation within an interchannel environment on the middle foreslope, and are composed primarily of Facies 1 and 2. A thin fining-up unit of Facies 4a at the base of piston core VEC89A-20 may represent either an abandoned turbidity current channel sequence, or a series of unconfined turbidity currents. Further basinward, piston cores VEC89A-18 and VEC89A-23 represent deposition in an elevated saddle on the lower foreslope (Figure 4-3). These cores consist of Facies 1 overlying Facies 4a. Beds are both normally and inversely graded, and bed contacts are abrupt and locally loaded.

### *Roberts Bank Slope*

Roberts Bank slope is the entire study area south of the Sand Heads Sea Valley. The delta slope here is currently subject to active sediment supply from the Fraser River. However, shallow seismic profiling off Roberts Bank suggests that the slope in this area is undergoing local sediment failure and may be primarily an area of erosion (Hart *et al.*, 1992b).

Piston core VEC89A-46 was recovered immediately seaward of two abandoned distributary channels on Roberts Bank (Figure 4-1). It consisted of a 1 m interval of Facies 3 and 4c overlying Facies 4a. A single loaded contact overlain by oversteepened lamination was found at the base of a 10 cm thick unit of Facies 4c. This suggests periods of rapid sedimentation and an associated elevation of pore fluid pressures. Larger scale oversteepened laminations are present near the base of the interval.

Piston cores VEC89A-41, VEC89A-42 and VEC89A-44 are all composed of thick sand-rich sequences (Facies 4) overlain by finer grained sediment (Figure 4-4). The sands are silty, very fine to medium-grained, moderately sorted and exhibit evidence for traction deposition and channelized flow. These units are usually massive, although well developed wavy and/or plane parallel laminations and rare clay rip-up clasts are present locally. High frequency (3.5 kHz) siesmic profiles show evidence of channel bank scour and downlap of reflectors into the channel floor along the southeast channel flank (Figure 4-4). This is interpreted to reflect northward channel migration, with piston core VEC89A-42 representing the current bathymetric expression of the channel. The channel is currently inactive, with a thin drape (10 to 15 cm) of clayey silt covering the channel floor (Figure 4-4). This channel has been named Roberts Bank Channel to distinguish it from the active Sand Heads Sea Valley (Kostaschuk *et al.*, 1992a) to the north.

The base of the foreslope at piston core site VEC89A-45 consists of greater than 80% massive, fine-to medium sand (Facies 4c); internal structure consists of oversteepened bedding and convolute laminations (Figure 4-5). The thick sand intervals have no active upslope sediment source. Deposition appears to be by traction on a depositional lobe associated with the mouth of the Roberts Bank Channel. Morphologic expression of this feature suggests that it represents a small fan associated with channel debouchment at the base of the delta foreslope. Sand deposition may be from a series of small scale constructional channels (Figure 4-5). This lobe is currently inactive.

Core VEC89A-39, in the lower-middle foreslope on southern Roberts Bank, is composed of Facies 3 overlying Facies 4. The probable depositional environment is an abandoned channel. Although there is no bathymetric evidence for a channel up slope from this site, attenuation of the seismic signal and disruption of reflector continuity (Figure 4-6) may reflect a relict channel. This suggests that sedimentation rates have been high enough to completely bury the morphologic expressions of abandoned channels or slump scars.

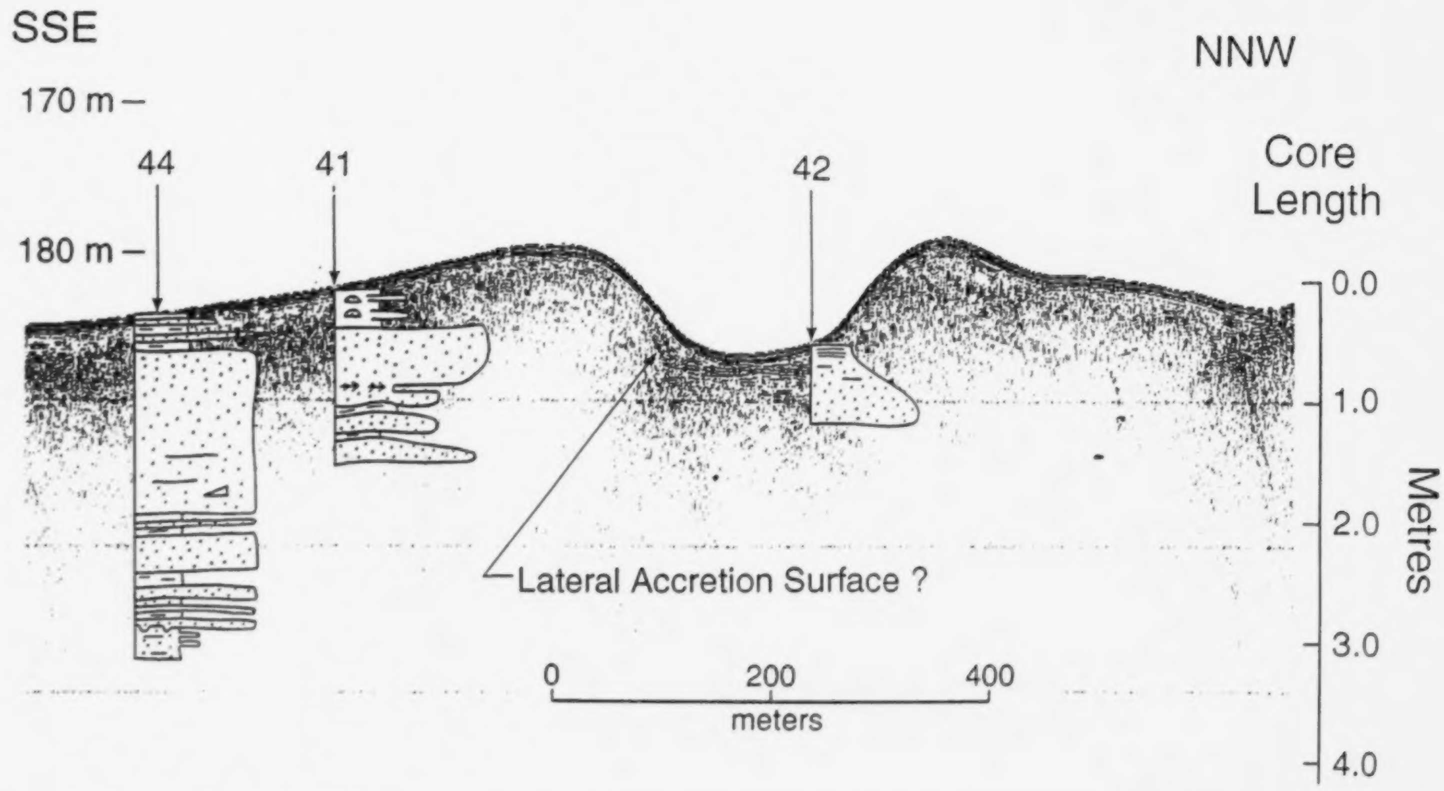
SSE
NNW
170 m –
180 m –
44
41
42
Core
Length
0.0
1.0
2.0
3.0
4.0
Metres
Lateral Accretion Surface ?
0
200
400
meters

Figure 4-4. High resolution (3.5 kHz) seismic profile through the Roberts Bank Channel correlated to 3 piston cores showing lateral facies variability and seafloor morphology. Note evidence of reflector downlap onto the channel floor, and channel bank scour surfaces interpreted to represent northward channel migration. Thin clayey-silt drape on the channel floor represents channel abandonment. Vertical exaggeration of piston core logs is approximately 8X. See Figure 4-1 for location.

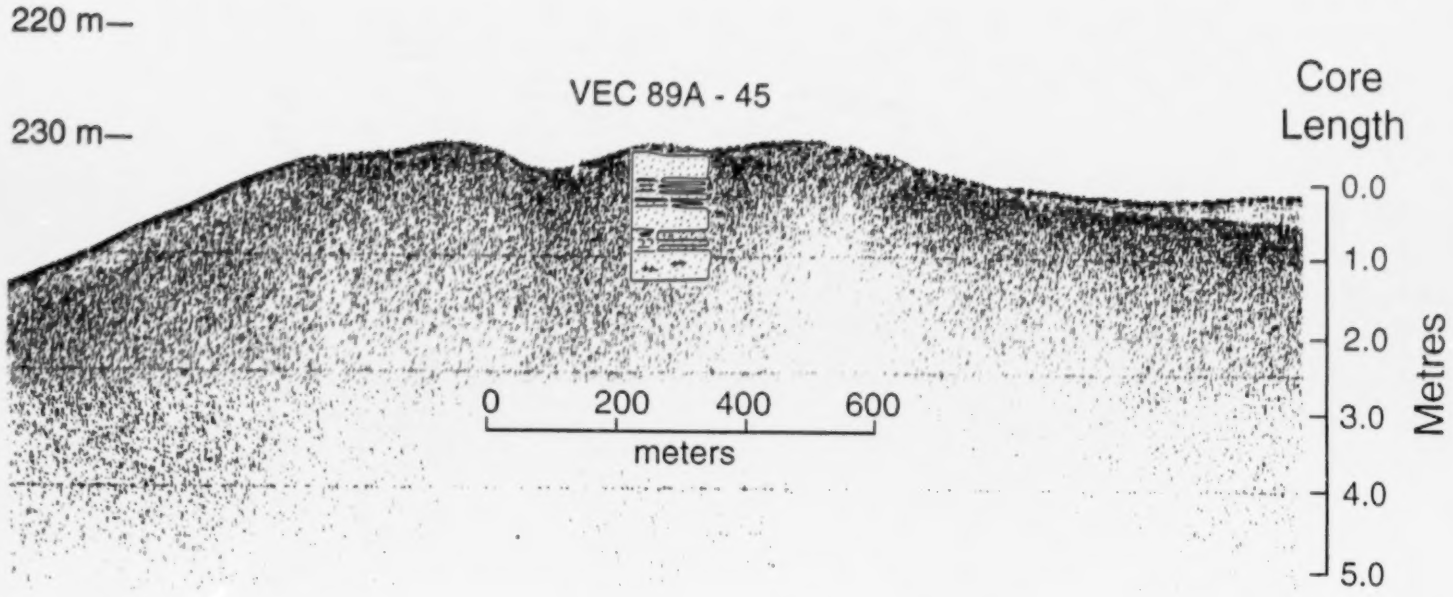

Figure 4-5. Sedimentologic character, morphologic expression, and internal seismic structure of depositional lobe at piston core site VEC89A-45. This lobe is associated with the terminus of the Roberts Bank Channel and interpreted as a small fan complex. Note the presence of constructional-depositional(?) channels on the fan surface. Vertical exaggeration of piston core logs is approximately 8X, total core length is 1.65 m. See figure 4-1 for location.

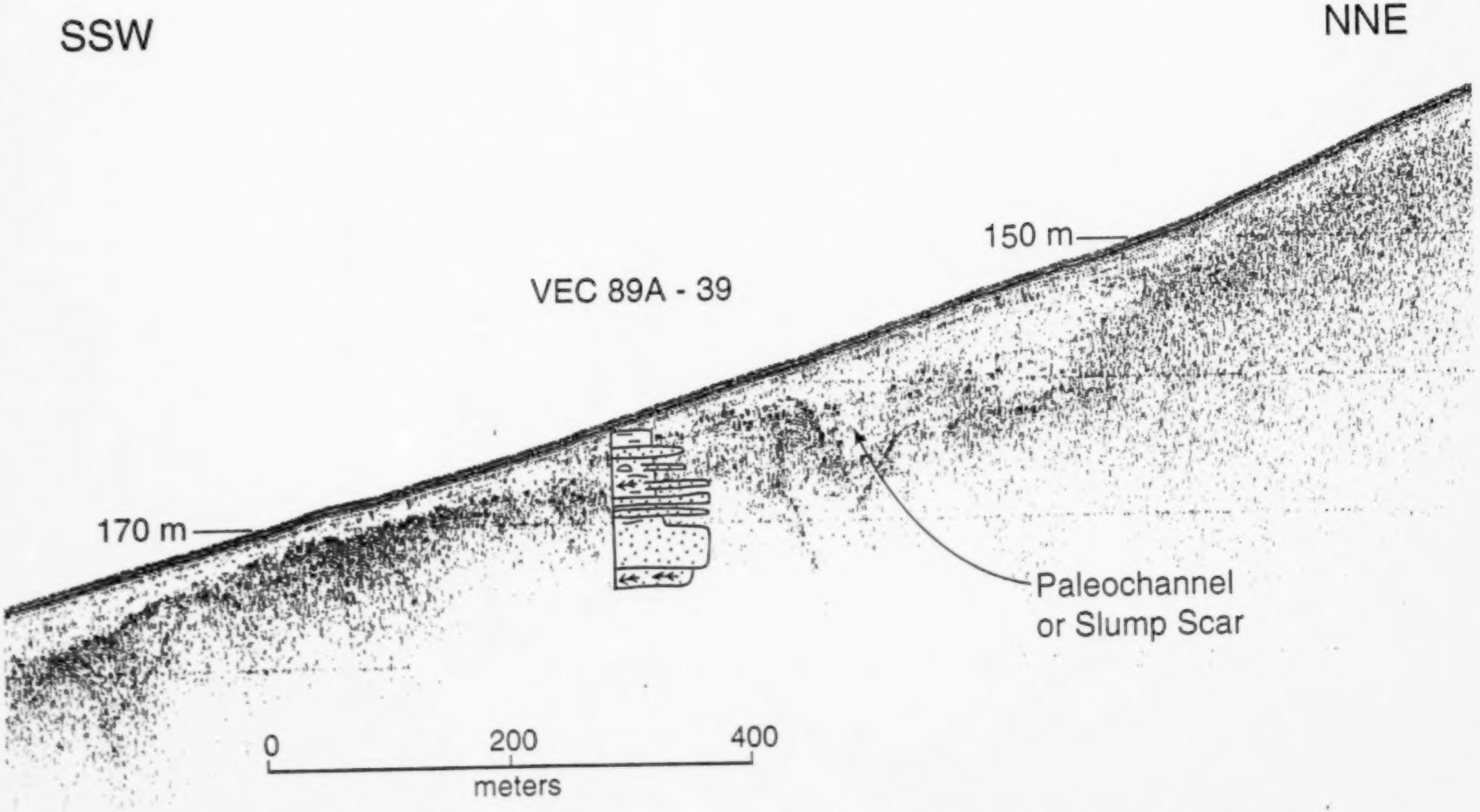
SSW
NNE
150 m
VEC 89A - 39
170 m
Paleochannel
or Slump Scar
0
200
400
meters

Figure 4-6. Interpreted channel-fill sedimentary sequence recovered in piston core VEC89A-39 correlated to 3.5 kHz high frequency seismic line on Roberts Bank. No bathymetric expression of this channel is preserved; however, a probable infilled channel, or slump scar, is evident on high resolution seismic records. Piston core length is 1.32 m. See figure 4-1 for location.

A thin unit of Facies 5 was encountered in the prodelta down dip from piston core VEC89A-39 in core VEC89A-40. The seismic expression of this unit is laterally continuous for a minimum distance of 700 m in a down dip direction (Figure 4-7). Although there is no evidence of active channels or channelized flow in cores collected upslope from this site, a pronounced embayment in the bathymetric contours between piston core sites VEC89A-40 and VEC89A-39 (Figure 4-1) is of appropriate scale to represent a significant slump scar on the foreslope.

### *Sand Heads Sea Valley*

Piston core VEC89A-03 was drilled along the flank of the Sand Heads Sea Valley. The core is composed entirely of Facies 4, and represents a stacked, well developed channel sequence with normally graded beds and pronounced coarsening and thickening-up sequences (Figure 4-8). Deposition is from traction at the base of channelized turbidity currents. Piston core VEC89A-06, 800 m north of core site VEC89A-03 on the inferred levee of the Sand Heads' Sea Valley, represents a weakly defined fining upwards sequence with Facies 2 and minor Facies 4b overlain by Facies 1 (Figure 4-8). Interpreted depositional processes are channel overbank or inter-channel flow by dilute, unconfined turbidity currents and concurrent background deposition of silty clay from suspension fallout.

### *Lateral Facies Variability*

The significance of channelized subenvironments in the development of the geometry and internal architecture of the delta front is apparent from depositional strike sections. Transverse section D - D' (Figure 4-1) demonstrates the importance of coarse grained siliciclastic material in the depositional framework of the Fraser River delta (Figure 4-8). The piston cores on this section were all recovered from water depths between 160 and 190 m. All but one of these cores contain some fine-to medium-grained sand beds (Facies 4), and Facies 4a sands are a significant component of the total recovered sediment (> 30%) in five of the seven cores.

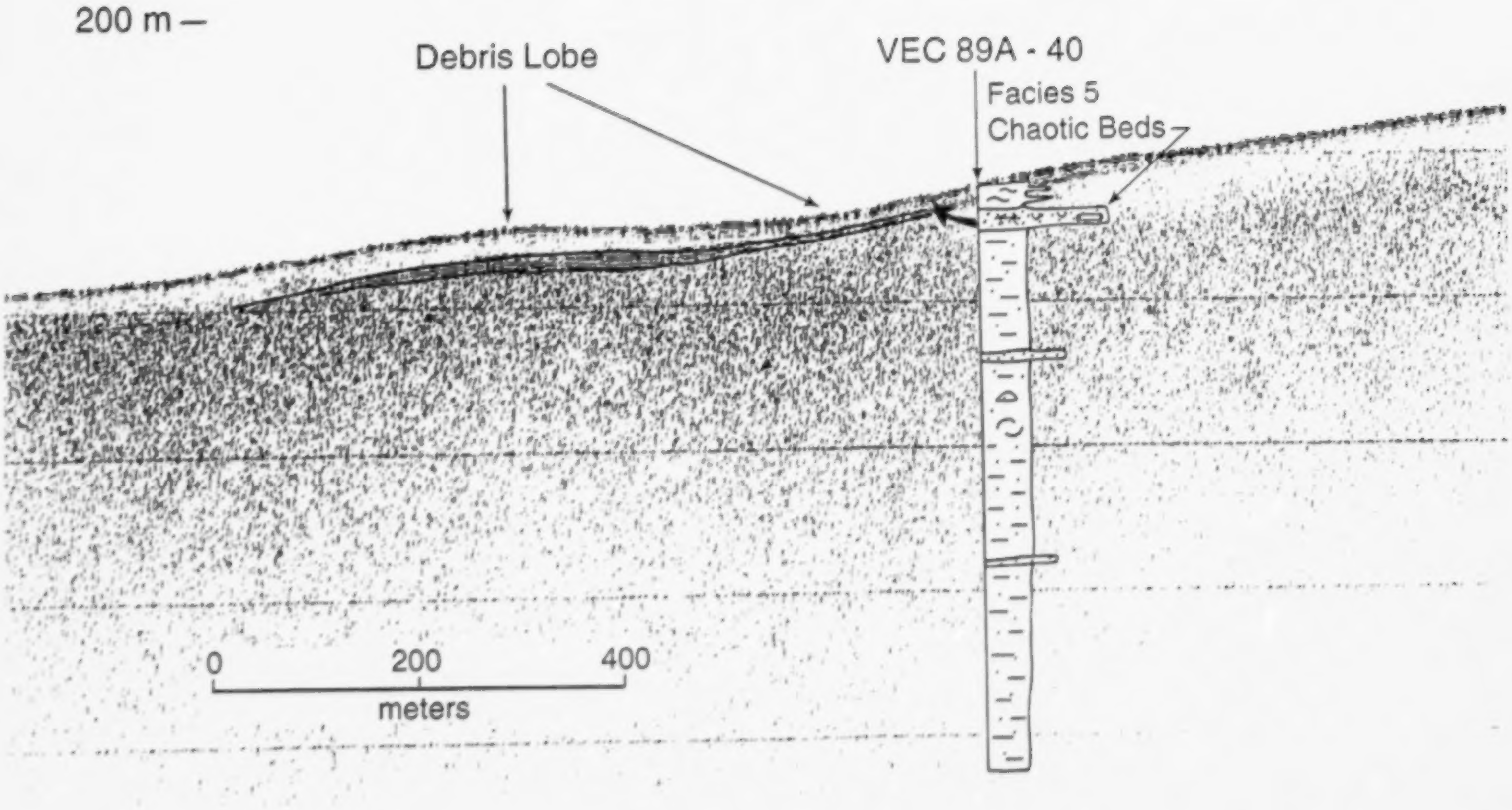
200 m –
Debris Lobe
VEC 89A - 40
Facies 5
Chaotic Beds
0
200
400
meters

Figure 4-7. High frequency (3.5 kHz) seismic profile in vicinity of piston core VEC89A-40 showing thickness and lateral (down-dip) continuity of facies 5 chaotic beds. Vertical exaggeration of piston core is approximately 8X, total core length is 4.86 m. See Figure 4-1 for location.

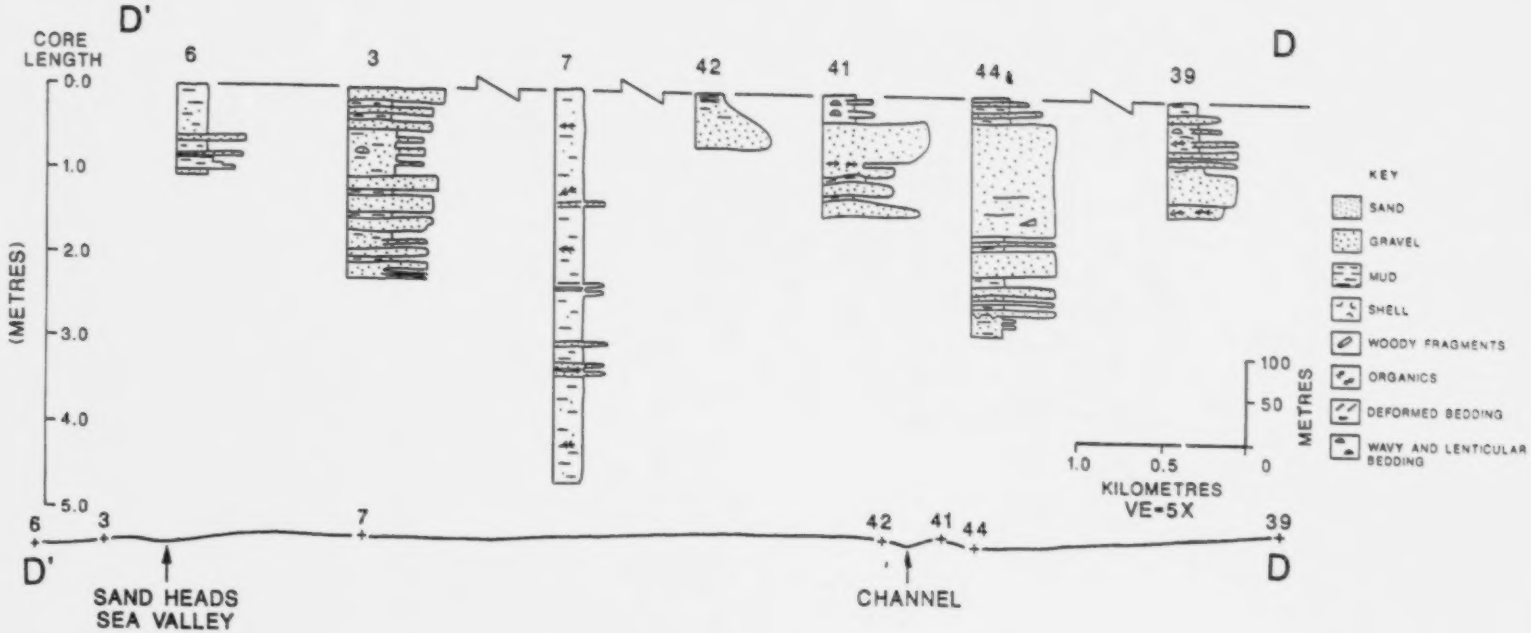
D'
D
CORE LENGTH
(METRES)
0.0
1.0
2.0
3.0
4.0
5.0
6
3
7
42
41
44
39
KEY
SAND
GRAVEL
MUD
SHELL
WOODY FRAGMENTS
ORGANICS
DEFORMED BEDDING
WAVY AND LENTICULAR BEDDING
100
50
0
METRES
1.0
0.5
KILOMETRES
VE=5X
SAND HEADS SEA VALLEY
CHANNEL

Figure 4-8. Depositional strike section D-D' near the base of the delta foreslope showing sedimentary facies variability at approx. 180 m water depth. Note the preponderance of facies 4 sands. Vertical exaggeration on bathymetric profile at the bottom of the figure equals 5X. See Figure 4-1 for location.

Piston core VEC89A-07 represents an interchannel environment on the lower foreslope between the inactive Roberts Bank Channel and the Sand Heads Sea Valley (Figure 4-8). Sediments consist primarily of silty clay (Facies 1) deposited from suspension, with minor deposition of sand from the entrained layer of unconfined turbidity currents (Facies 2). Rare *Paleophycus* burrows are associated with thin sand intervals between 2.8 and 3.4 m. Rafted organics and wood fragments, both disseminated and bedded, are present in the non-bioturbated intervals.

## Summary and Conclusions

Five sedimentary facies are recognized in piston cores from channel-margin, interchannel and depositional lobe environments on the Fraser River delta foreslope. Massive to finely laminated silty clays to clayey silts of Facies 1 and 2 are interchannel sediments deposited primarily by suspension settling from the river plume and weak traction currents. Facies 3 is an interbedded clayey silt to very fine-to medium-grained sand that is planar laminated and lenticular bedded, and deposited by a combination of suspension settling and low-density turbidity currents. Facies 3 occurs primarily along the margins of foreslope channels that are likely relict levees. Silty very fine-to medium-grained sand with silty clay interbeds of Facies 4a are wavy to lenticular bedded, soft-sediment deformed, graded, and occasionally over-steepened. This facies occurs along the margins of both active and inactive channels and was deposited by suspension settling, traction and mass wasting processes during lateral channel migration and abandonment. Thin to thick bedded, massive to laminated silty very fine-to medium-grained sands of Facies 4a and 4b were deposited by high-to-low density turbidity currents along channel margins and as depositional lobes at the base of the delta foreslope at the terminus of foreslope channels. These lobes are small-scale fans deposited by channelized turbidity currents. The best example of such a fan/lobe is found in association with the inactive Roberts Bank Channel in 230 m of water (Figure 4-5). This lobe represents an important mechanism and product of "sand by-passing" across the delta foreslope.

Sedimentary evidence of possible debris flows is found in only one core, located on Roberts Bank immediately downslope of a slump scar on the foreslope (Figure 4-7). The debris flow deposit (Facies 5) is composed of resedimented organics, shell fragments and poorly sorted very fine-to medium sand with silty clay rip-up clasts in a silt/clay matrix. Even though the spatial distribution and depth of cored sediment is limited, it appears that debris flows are relatively insignificant as a process of sediment remobilization and deposition. Conversely, from sedimentologic observations, most of the foreslope sand deposits are the product of low-to-high density turbidity currents. Turbidity currents in the Sand Heads Sea Valley result from mass wasting of sediment at the mouth of the river in response to rapid sediment loading (Kostaschuk *et al*, 1992a). The Roberts Bank Channel and depositional lobe are presumed to have a similar origin.

The incision of multiple channels through time on the delta foreslope has resulted in a high degree of along-slope lateral facies variability. An along-slope facies cross-section in 180 m water depth documents the relative importance of sand deposition on the Fraser River delta foreslope. Channelized turbidity current transport of coarse sediment across the relatively steep (3°) slope ("sand by-passing") into water depths ≥ 250 m provides a process sedimentologic analogue for identification and/or reconstruction of ancient shelf-edge deltaic facies. In addition, the Fraser River delta foreslope may provide an opportunity to test theories of facies accumulation and sediment deposition during eustatic sea level low-stands.

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Hart, B.S., Prior, D.B., Hamilton, T.S., Barrie, J.V. and Currie, R.G., 1992b. Patterns and styles of sedimentation, erosion and failure, Fraser Delta slope, British Columbia. *In:* Geotechnique and Natural Hazards: Proceedings of First Canadian Symposium on Geotechnique and Natural Hazards. Canadian Geotechnical Society, p.365-372.

Kostaschuk, R.A., Church, M.A. and Luternauer, J.L., 1989. Bedforms, bed material, and bedload transport in a salt-wedge estuary: Fraser River, British Columbia. *Canadian Journal of Earth Sciences*, v.26, p.1440-1452.

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Kostaschuk, R.A., Church, M.A. and Luternauer, J.L., 1992b. Sediment transport over salt-wedge intrusions: Fraser River estuary, Canada. *Sedimentology*, v.39, p.305-317.

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Moslow, T.F., Luternauer, J.L. and Kostaschuk, R.A., 1991. Patterns and rates of sedimentation on the Fraser River delta slope, British Columbia. *In:* Current Research, Geological Survey of Canada, Paper 91-1E, p.141-145.

Moslow, T.F., Evoy, R.W. and Luternauer, J.L., 1993. Implications of Cs-137 sediment profiles for sediment accumulation rates on the Fraser River delta foreslope, British Columbia. *In:* Current Research, Geological Survey of Canada, Paper 93-1A, p.255-261.

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# CHAPTER 5.

# COMPARATIVE GEOMETRY OF SUBAQUEOUS CHANNEL FACIES, FRASER RIVER DELTA FORESLOPE, BRITISH COLUMBIA: IMPLICATIONS FOR THE DEPOSITION OF LOWSTAND SANDS.[4]

## Introduction

The significance of sediment bypassing of the continental shelf in the delivery of sand to deeper-water environments has long been recognized. The resultant sand bodies provide excellent hydrocarbon targets as they are frequently encased by marine shales that provide both seals and potential source material. These sands may also represent the sole evidence for significant fluctuations in relative sea level.

The Fraser River delta, a coarse-grained delta prograding directly into water depths exceeding 200 m, provides a modern process analogue for sediment bypassing from shallow to "deep" water environments. Delta sedimentation was initiated during a relative sea level fall, followed by minimal transgression, due to the interplay between isostatic rebound and eustatic sea level rise. The delta slope is dominated by fluvial processes, and the role of extrabasinal control over basin geometry is significant. Earthquake activity may play a role in initiating the remobilization of sediment via seismic loading.

This study builds on the results of ongoing research documenting sediment accumulation rates (Evoy, 1992; Evoy *et al.*, 1993b), textural parameters and sedimentary fabric (CHAPTER 3), and the distribution of sedimentary facies across the Fraser River delta foreslope (Evoy *et al.*, 1993a; 1994; see also Table 5-1). The integration of vibrocoring results with high frequency seismic profiles, detailed sedimentologic descriptions, and textural and mineralogic analyses of the cores results in a unique data set with which to study the origin, geometry and variability of sedimentary facies in submarine channels and associated

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[4] A version of this chapter has been submitted for publication. Evoy, R.W. and Moslow, T.F. Journal of Sedimentary Research.

TABLE 5-1: SUMMARY OF MAIN SEDIMENTARY FACIES CHARACTERISTICS (modified from Evoy *et al.*, 1994)

| Facies Designation | | Lithology | Sedimentary and Bedding Characteristics |
|---|---|---|---|
| Facies | Depositional Process | | |
| 1, 2 | suspension sedimentation | silty clay to clayey silt; <10% silt or v.fine sand as discrete laminations. | massive to plane parallel laminated; rare wavy to lenticular beds; bedded and disseminated organics. |
| 3 | mixed traction/suspension sedimentation | interbedded clayey silt with v.fine/fine sand; silt > sand. | plane parallel laminations; lenticular bedding; contacts gradational, rarely abrupt. |
| 4a | channel fill sands: lateral accretion, vertical aggradation, and slumping. | silty, v.fine to medium sand <10% silt/clay interbeds | massive, wavy or lenticular bedding; normal to inverse grading; convolute laminations, oversteepened bedding; rare load casts; contacts gradational or sharp, thickens/coarsens upwards. |
| 4b | low density turbidity currents | silty v.fine to fine sand in beds <10cm thick | massive, poorly sorted; contacts sharp or gradational; erosive bases. |
| 4c | high density turbidity currents | silty, fine to medium sand | massive, mud rip-up clasts; abrupt contacts. |
| 5 | debris flows | resedimented organics, shell fragments and sand; silt/clay matrix | poorly sorted, chaotic; mud rip-up clasts. |

depositional lobes on a delta foreslope.

The unique geographic setting, and the presence of sand-sized clastic detritus being introduced directly into water depths exceeding 200 m, may serve as an analogue to lowstand (shelf-edge) deltas. The Fraser River delta foreslope therefore represents an ideal process analogue for investigating the variability in siliciclastic facies deposited on the outer continental shelf during a relative sea level fall.

### *Setting*

The Fraser River delta is a deep-water delta (Postma, 1990) with a pronounced foreslope developed below the influence of most surface waves (Hart *et al.*, 1992a), and is currently building out into water depths in excess of 200m. The seaward margin of the Fraser River delta consists of a series of broad tidal flats up to 9 km in width with an average slope of less than 0.1°. The foreslope extends a further 5 to 10 km seaward at an average gradient exceeding 3.0°. The delta slope can be subdivided into upper, middle and lower foreslope based on water depth and sediment delivery patterns (Figure 5-1). The delta is sourced with relatively coarse-grained detritus via strongly seasonal discharge (Kostaschuk *et al.*, 1989a), experiences large tidal draw down, is protected from excessive storm waves by the limited fetch across the Strait of Georgia, and exists within one of the most active seismic regimes in Canada (Luternauer, 1988).

Much of the coarsest sediment supplied to the mouth of the delta bypasses the delta plain and upper foreslope and is introduced directly to the lower foreslope and basin floor. The foreslope is cut by two prominant sand-floored channels hundreds of metres wide and over 10 m in relief (Kostaschuk *et al.*, 1992; Hart *et al.*, 1992a; Evoy *et al.*, 1993a). These channels debouche onto the basin floor producing a series of sand-rich depositional lobes in water depths of 200 to 250 m (Moslow *et al.*, 1991; 1993; Evoy *et al.*, 1993b). These channels are initiated and maintained by sediment gravity flow processes related to periodic liquifaction and failure at the head of the foreslope (McKenna and Luternauer, 1987;

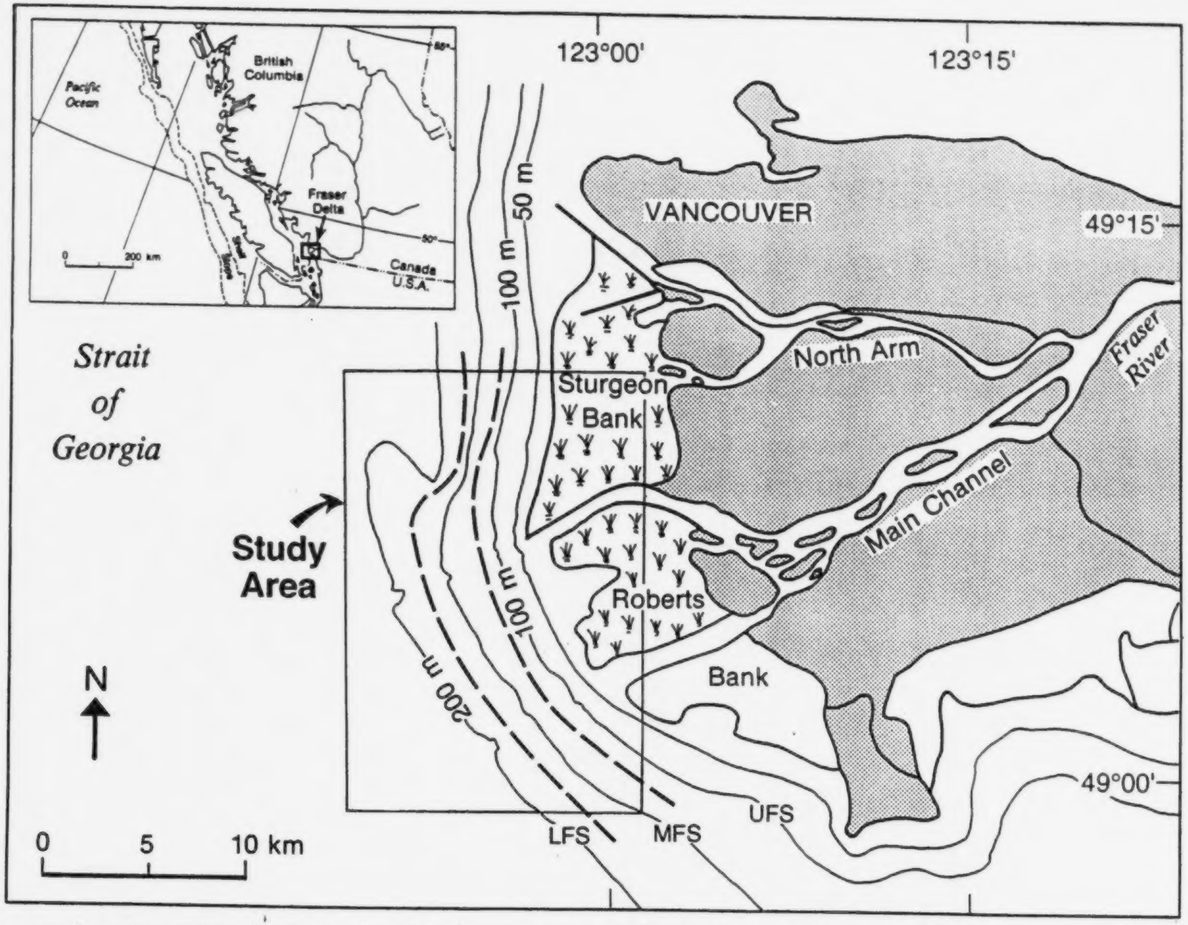

123°00'
123°15'
49°15'
49°00'
Pacific Ocean
British Columbia
Fraser Delta
Canada
U.S.A.
200 km
Strait of Georgia
VANCOUVER
North Arm
Main Channel
Fraser River
Sturgeon Bank
Roberts Bank
50 m
100 m
200 m
UFS
MFS
LFS
Study Area
N
0
5
10 km

Figure 5-1. Study area location map with generalized bathymetry and main physiologic elements of the Fraser River delta foreslope. Patterned area denotes intertidal sand and mud flat; UFS, MFS and LFS refer to upper, middle and lower foreslope areas respectively.

McKenna *et al.*, 1992; Kostaschuk *et al.*, 1992; Hart *et al.*, 1992a).

Inception of sedimentation in the Fraser River delta at the beginning of Holocene time was coupled with an isostatically driven fall of local sea level exceeding 100 m (Clague *et al.*, 1982). The ensuing transgression during the past 8,000 years is on the order of 10 to 13 m (Clague *et al.*, 1983; Williams and Roberts, 1989).

The Roberts Bank Channel is located in the centre of the study area (Figure 5-2), and is currently inactive and mantled with a thin sediment drape. Although minor sand-sized sediment input may be sourced by longshore sandwave migration, the channel has likely not experienced a direct sediment source since upstream channel avulsion in the mid-1800's (Johnston, 1921; Luternauer and Finn, 1983). As such, the Roberts Bank Channel predates any appreciable anthropogenic mediation and represents the closest approach to a natural setting on the delta foreslope.

The Sand Heads Sea Valley, off the Main Arm of the Fraser River is the only subaqueous channel currently active (Figure 5-2). The position of the Main Arm of the Fraser River has been culturally fixed by the construction of the Steveston Jetty in the 1930's, and is modified by continual dredging of the main navigation channel. The impact of man-made structures has significantly altered sedimentation patterns and minimized the likelihood of future channel avulsion (Clague *et al.*, 1983).

### *Database and Methodology*

This study integrates the results of a number of detailed vibracoring surveys with high-frequency (3.5 kHz) seismic surveys conducted by the Geological Survey of Canada. The data set for this study consists of sedimentologic descriptions of approximately 90 vibracores, piston cores and gravity cores, plus several hundred kilometers of high frequency seismic profiles (Figure 5-2). Data acquisition was concentrated on the immediate vicinity of the

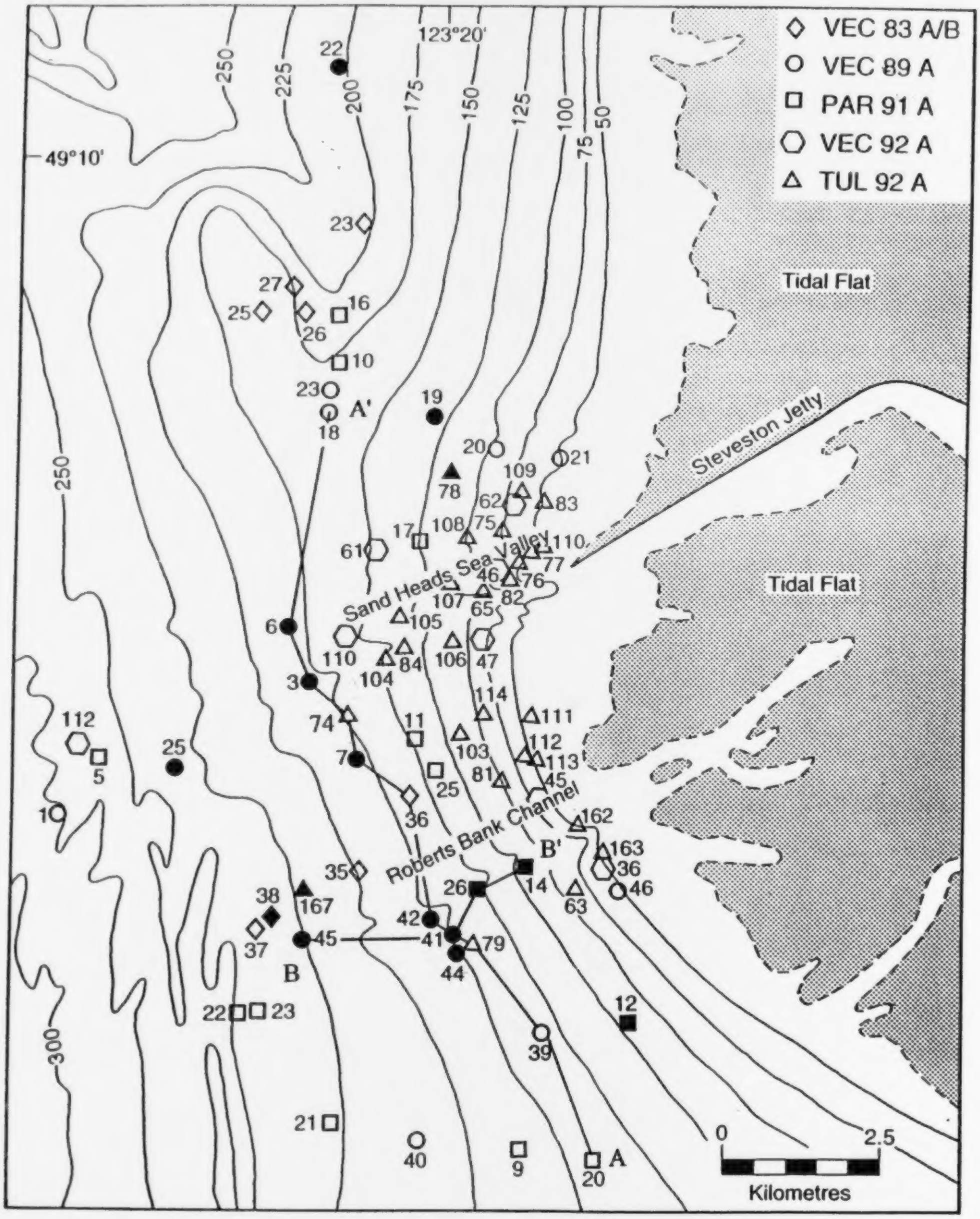

◇ VEC 83 A/B
○ VEC 89 A
□ PAR 91 A
⬡ VEC 92 A
△ TUL 92 A
123°20'
49°10'
250
225
200
175
150
125
100
75
50
250
300
Tidal Flat
Tidal Flat
Steveston Jetty
Sand Heads Sea Valley
Roberts Bank Channel
A'
A
B'
B
22
23
27
25
26
16
10
23
18
19
20
21
78
109
62
83
108
75
17
61
110
77
46
76
107
82
65
6
105
110
84
106
47
104
3
114
111
74
11
112
103
113
7
81
45
112
5
25
1
36
25
162
163
36
46
35
14
26
63
38
167
42
41
79
37
45
44
12
22
23
39
21
40
9
20
0
2.5
Kilometres

Figure 5-2A. Detailed bathymetry of the Fraser River delta foreslope in the study area with database compilation for sediment cores, as identified in the legend. Core sites denoted with closed symbols are discussed in the text.

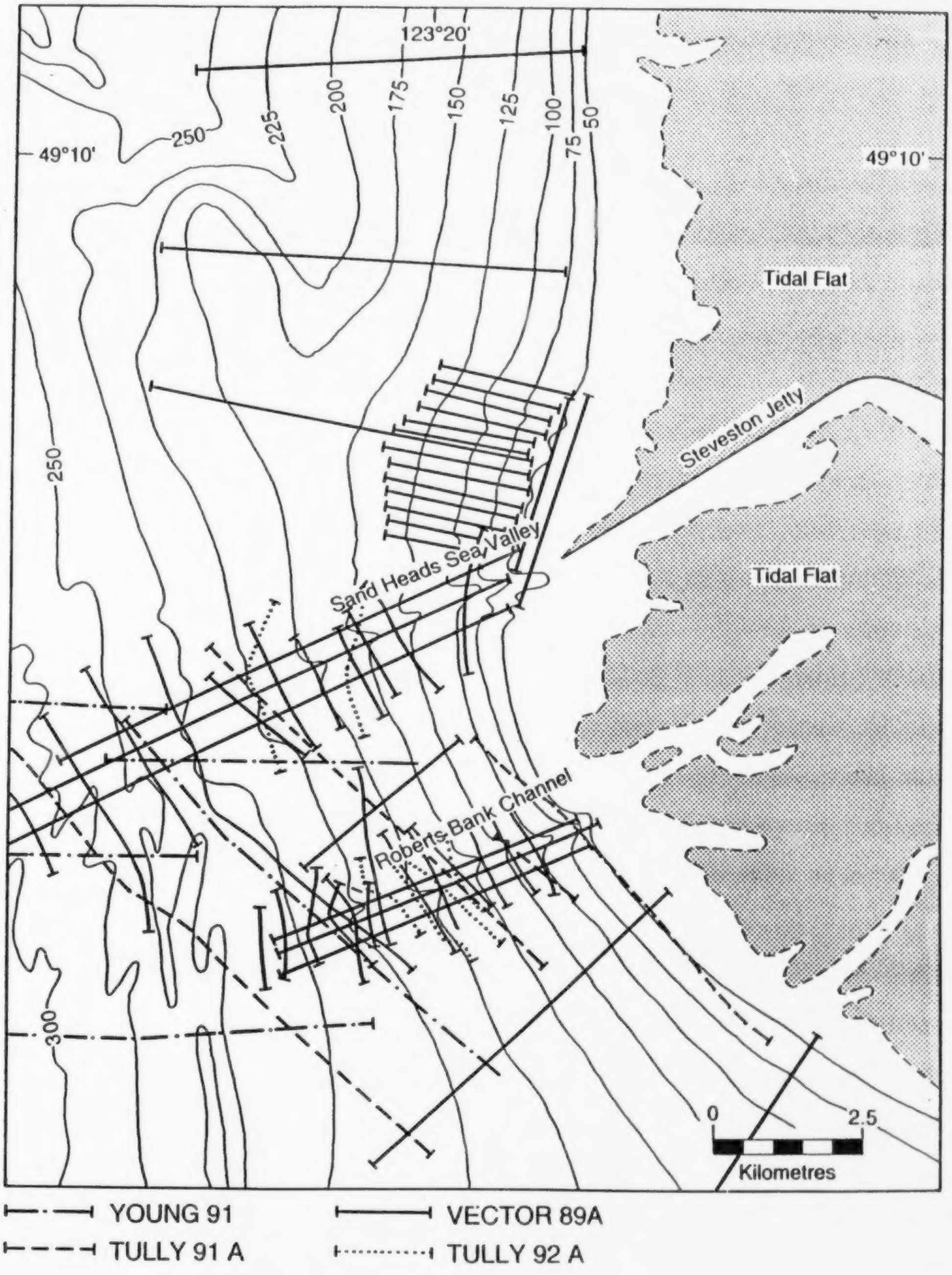

123°20'
49°10'
250
225
200
175
150
125
100
75
50
49°10'
Tidal Flat
Steveston Jetty
Sand Heads Sea Valley
Tidal Flat
250
Roberts Bank Channel
300
0
2.5
Kilometres
YOUNG 91
VECTOR 89A
TULLY 91 A
TULLY 92 A

Figure 5-2B. Detailed bathymetry of the Fraser River delta foreslope in the study area with high-frequency seismic lines, as identified in the legend.

major subaqueous channels and their depositional lobes. Detailed textural analysis of vibracores delineates depositional architecture and facies variability trends in delta front sands from depositional lobes formed at the channel mouths.

### *Sedimentary Facies*

Five sedimentary facies are recognized in piston cores collected from channel-margin, interchannel and depositional lobe environments on the Fraser River delta foreslope (Table 5-1) and have been described in detail elsewhere (Evoy *et al.*, 1994). Suspension sediments deposited directly from the river plume (Facies 1 and 2) are predominantly structureless to finely-laminated silts and mud. Suspension deposition is ubiquitous on the delta foreslope, and represents the ambient background sedimentation condition of the subaqueous delta. Mixed traction and suspension sedimentation, consisting of interbedded clayey silts and very fine- to medium-grained sands (Facies 3), occurs primarily at the head, or along the flanks, of subaqueous channels in the upper foreslope. Thick-bedded channel sands are composed of silty, fine-grained sands with less than 10% thin clay or silt interbeds, and occur along the margins of both active and inactive channels. High-density turbidites consist of massive, fine- to medium-grained sand, and are restricted to channel thalwegs or associated depositional lobes at the base of the foreslope. Thin-bedded, low-density turbidites and debris flows are volumetrically insignificant, and are not restricted by subenvironment (Evoy et al., 1994).

### *Background Sedimentation - Sturgeon and Roberts Banks*

Sturgeon Bank is a 75 km$^2$ depositional lobe north of the Steveston Jetty and the Sand Heads Sea Valley (Figure 5-1). The foreslope off Sturgeon Bank is currently inactive and has not had a direct sediment source since the earliest 1900's (Clague *et al.*, 1983) being isolated from the Main Arm of the Fraser River since the completion of the Steveston Jetty. The area is underlain by subparallel continuous reflectors which drape relief on the underlying sediments (Hart *et al.*, 1992b).

Background sedimentation in the prodelta to basinal environment at the base of the foreslope is dominated by passive settling of sediment from suspension. Cesium-137 analyses have demonstrated a minimum sediment accumulation rate of 0.76 cm/yr for the period 1954 to 1989 (Evoy *et al.*, 1993a). Internal sedimentary structures in prodelta cores consist of massive, to weakly burrowed, silty clay to clayey-silt with rare silty laminations and minor rafted organic debris (Figure 5-3a). Similar characteristics are present on the foreslope of Sturgeon Bank proximal to the Sand Heads Sea Valley (Figure 5-3b and 5-3c).

The Roberts Bank foreslope encompasses the entire study area south of the Sand Heads Sea Valley, and is currently subject to active sediment supply from the Fraser River. However, shallow seismic profiling suggests that the slope in this area is undergoing local sediment failure and may be primarily an area of erosion (Hart *et al.*, 1992b). Sediment cores from interchannel areas on the foreslope exhibit sedimentologic characteristics similar to those above. The foreslope north of the Roberts Bank Channel is composed of clayey silt with minor burrows and woody organics, and rare planar laminated, silty, very fine-grained sand interbeds (Figure 5-4a). South of the channel, the foreslope consists of dark grey to black, weakly burrowed, sandy mud with minor organics, and rare planar laminated to ripple laminated silty sand (Figure 5-4b).

## Results

### *Roberts Bank Channel/Depositional Lobe*

Roberts Bank has been extensively cored, and the channel has been covered by closely-spaced, high-frequency (3.5 kHz) seismic survey lines (Figure 5-5). The Roberts Bank Channel is a broad, shallow bathymetric feature, approximately 200 m wide by 10 m deep, and bounded by gentle, well-developed depositional levees (Figure 5-6a). At the base of the foreslope, the channel debouches as a well-developed depositional lobe approximately 1000 m wide by 10 m thick, and composed predominantly of fine- to medium-grained sand. The transition from channelized environment to depositional lobe is relatively abrupt. The first

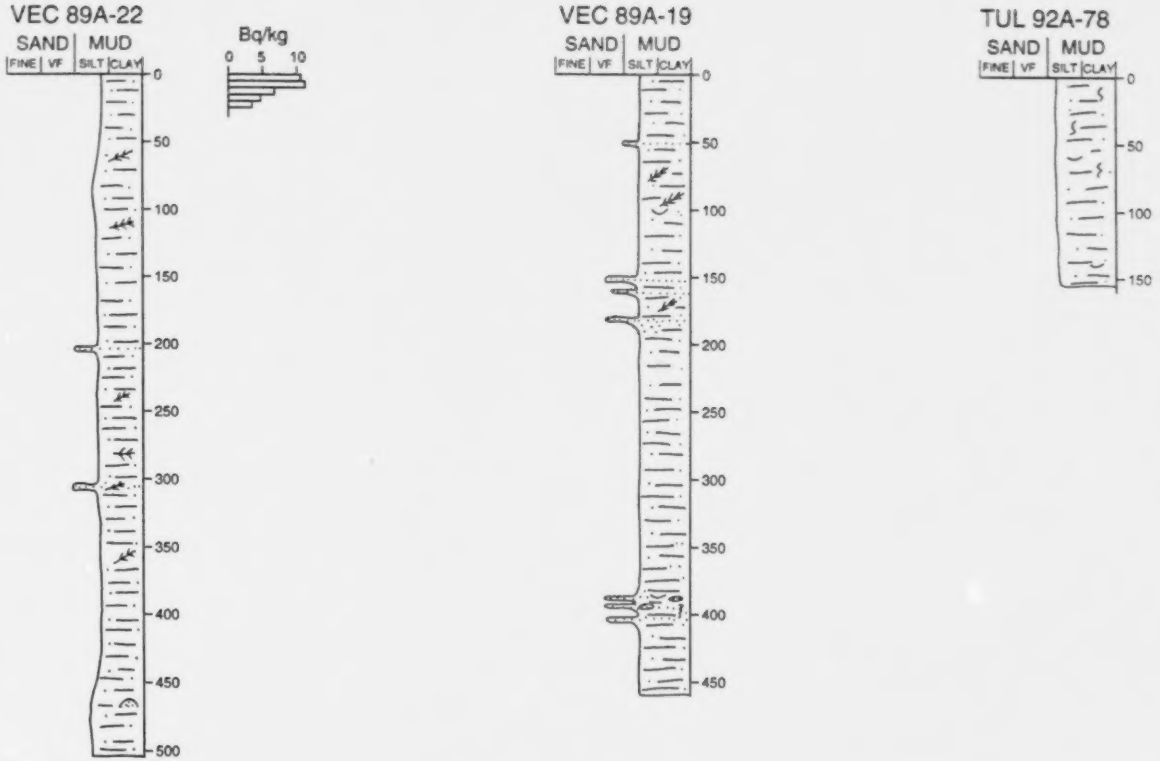

VEC 89A-22
SAND
MUD
FINE
VF
SILT
CLAY
0
50
100
150
200
250
300
350
400
450
500
Bq/kg
0
5
10
VEC 89A-19
SAND
MUD
FINE
VF
SILT
CLAY
0
50
100
150
200
250
300
350
400
450
TUL 92A-78
SAND
MUD
FINE
VF
SILT
CLAY
0
50
100
150

Figure 5-3. Sedimentologic logs for piston cores representative of Sturgeon Bank, see Figure 5-2A for location.
A). Sedimentologic log and $Cs^{137}$ profile for core VEC89A-22.
B). Sedimentologic log for core VEC89A-19.
C). Sedimentologic log for core TUL92A-78.

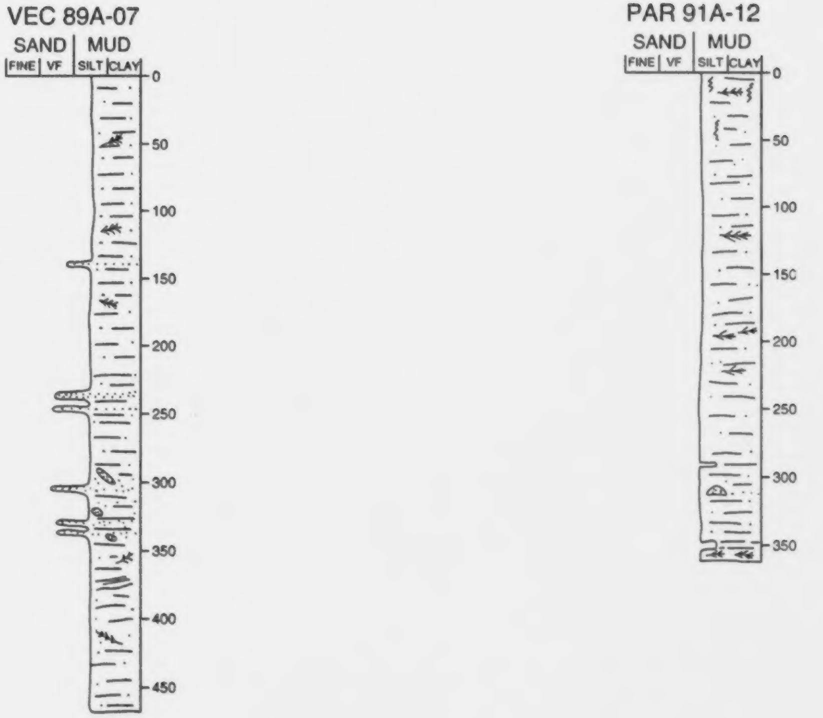

VEC 89A-07
SAND
MUD
FINE
VF
SILT
CLAY
0
50
100
150
200
250
300
350
400
450
PAR 91A-12
SAND
MUD
FINE
VF
SILT
CLAY
0
50
100
150
200
250
300
350

Figure 5-4. Sedimentologic logs for piston cores from Roberts Bank, see Figure 5-2A for location.
A). VEC89A-07 from the lower foreslope between Roberts Bank Channel and the Sand Heads Sea Valley.
B). PAR91A-12 from the middle foreslope south of the Roberts Bank Channel.

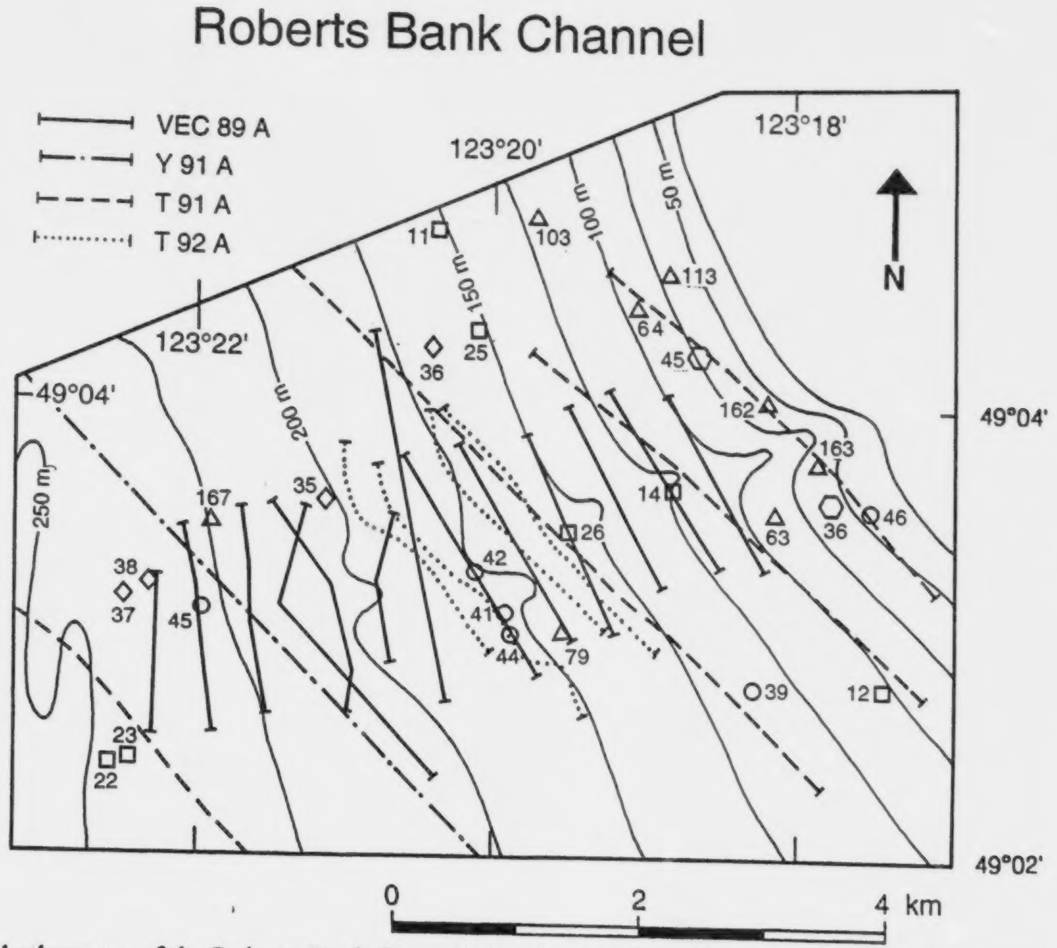

Roberts Bank Channel
VEC 89 A
Y 91 A
T 91 A
T 92 A
123°22'
123°20'
123°18'
49°04'
49°04'
49°02'
N
50 m
100 m
150 m
200 m
250 m
11
103
113
64
45
25
36
162
163
14
26
63
36
46
35
167
42
41
44
79
38
37
45
39
12
23
22
0
2
4 km

Figure 5-5. Detailed bathymetry of the Roberts Bank Channel showing location of core sites and high-frequency seismic line traces. See Figure 5-1 for location.

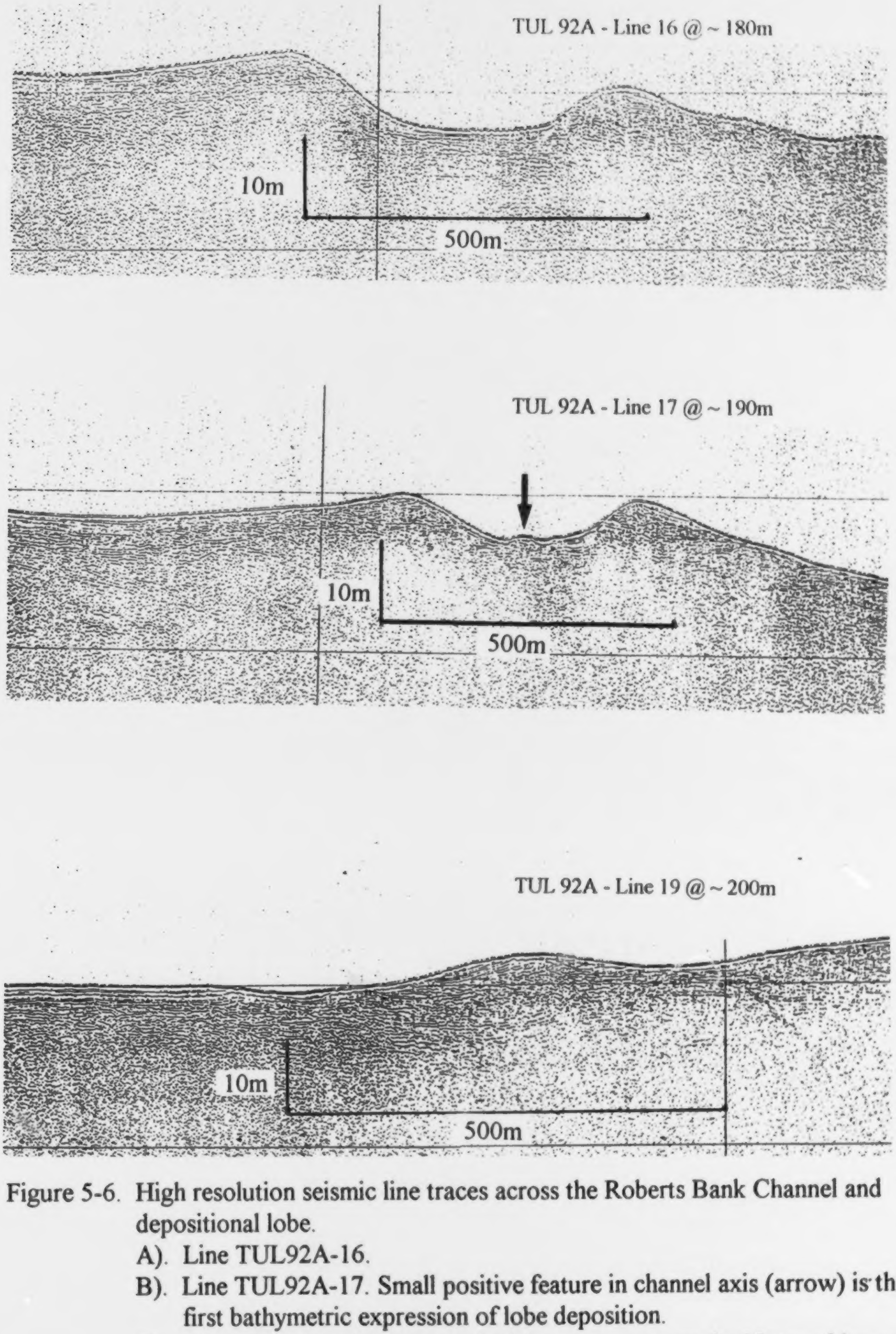

TUL 92A - Line 16 @ ~ 180m
10m
500m
TUL 92A - Line 17 @ ~ 190m
10m
500m
TUL 92A - Line 19 @ ~ 200m
10m
500m

Figure 5-6. High resolution seismic line traces across the Roberts Bank Channel and depositional lobe.

A). Line TUL92A-16.

B). Line TUL92A-17. Small positive feature in channel axis (arrow) is the first bathymetric expression of lobe deposition.

C). Line TUL92A-19 transects the lobe at an acute angle. Note evidence for lobe progradation in sigmoidal clinoforms downlapping into the basin on the northwest side of the depositional lobe.

positive bathymetric expression of the depositional lobe is encountered at a water depth of approximately 190 m, within the thalweg of the Roberts Bank Channel (Figure 5-6b). By approximately 205 m water depth, all expression of the channel is lost and the depositional lobe is well developed as a positive feature. Internal seismic structure within the lobe reveals a number of sigmoidal to tangential reflectors which downlap into the basin as a result of lobe progradation (Figure 5-6c).

An abundance of very fine- to fine-grained sand is supplied to the head of the Roberts Bank Channel and the upper foreslope. Piston cores recovered immediately seaward of abandoned distributary channels on Roberts Bank consist of interbedded traction and suspension deposits and thick-bedded channel sands (Evoy et at., 1994; CHAPTER 3). Rare loaded contacts, overlain by intervals of oversteepened laminations, suggest periods of rapid and/or differential sedimentation and an associated elevation of pore fluid pressures.

The middle foreslope appears to be largely a zone of sediment bypassing (CHAPTER 3). The channel levee was cored at 120 m water depth, near the transition from the upper to middle foreslope. Piston core PAR91A-14 consists of interbedded sandy silt and mud with very fine- to fine-grained silty sand and medium-grained sand in beds up to 25 cm thick (Figure 5-7a). The channel-fill at 160 m water depth is much finer-grained than in any other channel cores recovered, as is evident in percent sand, number and thickness of discrete sand beds, and mean grain size (Figure 5-7). Piston core PAR91A-26 is characterized by weakly burrowed muddy silt with minor very fine-grained sand as thin planar laminations, ripples, or discontinuous lenses (Figure 5-7b). Shelly debris and bedded organics are common in the upper foreslope, but only constitute a minor element of the accumulated sediment on the middle foreslope.

Channel-fill sediments on the lower foreslope are predominantly composed of thick sand beds overlain by finer-grained sediment (Figure 5-7c). These sands are silty, very fine- to medium-grained, and moderately sorted. These deposits are usually massive, although well

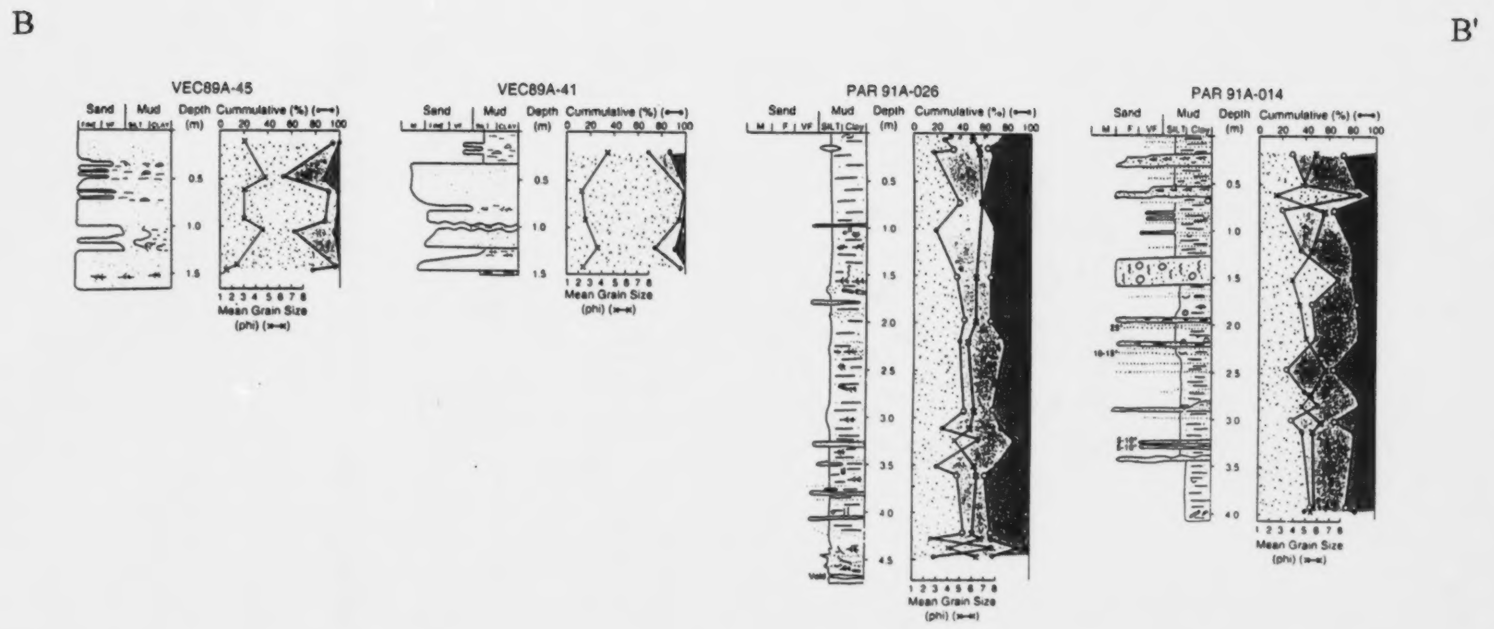


Figure 5-7. Sedimentologic logs with grain size distributions for piston cores collected along the axis of the Roberts Bank Channel documenting the degree of sand bypassing in the middle foreslope (PAR91A-26), and deposition at the base of the lower foreslope (VEC89A-45). Location shown on Figure 5-2A.

developed wavy and/or plane parallel laminations and rare clay rip-up clasts present local evidence for traction deposition and channelized flow. Seismic profiles show channel bank scour and downlap of reflectors into the channel floor along its southeast flank (Figure 5-8). This pattern is interpreted to reflect northward channel migration, with piston core VEC89A-42 representing the current bathymetric expression of the channel.

The Roberts Bank Channel debouches as a broad, depositional sand lobe at the base of the foreslope in approximately 230 m water depth (Figure 5-9). These sands represent the cleanest and coarsest sediment recovered from the foreslope on Roberts Bank (CHAPTER 3). Deposition in this lobe appears to be by traction as a series of small scale constructional channels.

The Roberts Bank lobe consists of greater than 80% massive, fine-to medium sand with oversteepened bedding and convolute laminations (Figure 5-10a). Gravity cores collected from the flanks of this depositional lobe are composed of silty muds or clayey silts with sharp based fine- to medium-grained sand beds. These sand beds are up to 15 cm thick and locally exhibit loaded bases (Figures 5-10b, 5-10c). Crudely bedded organics are common, and the basal mud-dominant portion of cores are variably burrowed to bioturbate (Figure 5-10b).

### *Sand Heads Sea Valley*

Most studies of sediment transport and failure in the subaqueous delta have concentrated on the Sand Heads Sea Valley area (eg. Kostaschuk *et al.*, 1989b; Hart *et al.*, 1992a; Kostaschuk *et al.*, 1992; McKenna *et al.*, 1992). The Sand Heads Sea Valley consists of a number of tributary channels (Figure 5-11) which rapidly coalesce to form a single, broad channel approximately 300 m wide, and up to 18 m deep. The main channel in the middle foreslope exhibits steep erosional valley walls marked by truncation of parallel reflectors and slumping due to erosional undercutting along the channel margins (Figure 5-12a). Relief

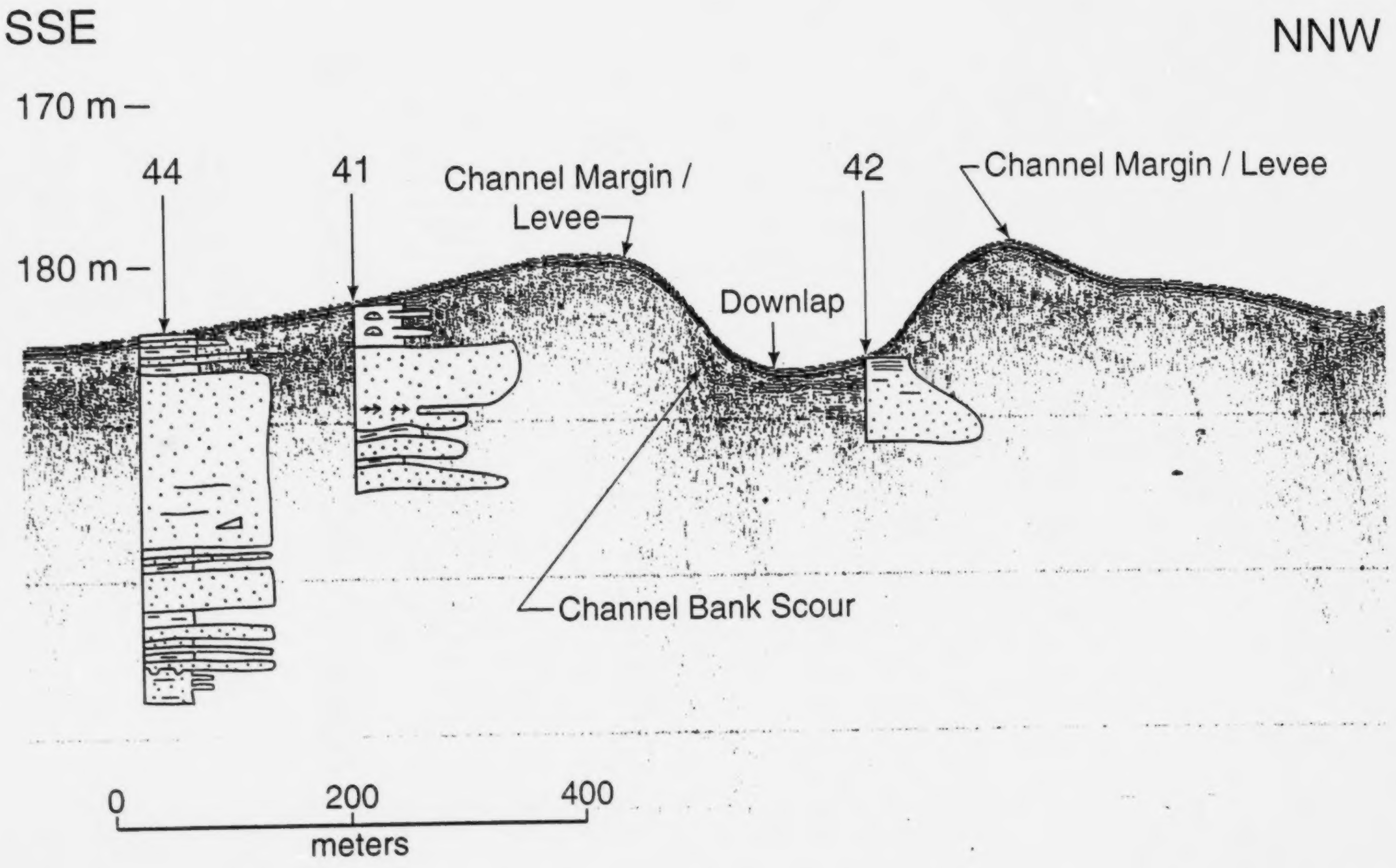

SSE
NNW
170 m –
180 m –
44
41
Channel Margin / Levee
42
Channel Margin / Levee
Downlap
Channel Bank Scour
0
200
400
meters

Figure 5-8. High frequency (3.5 kHz) seismic profile through the Roberts Bank Channel with piston cores showing lateral facies variability and seafloor morphology. Note evidence of reflector downlap onto channel floor, and channel bank scour surfaces. Thin clayey-silt drape on the channel floor is a product of channel abandonment. From Evoy *et al.*, 1994.

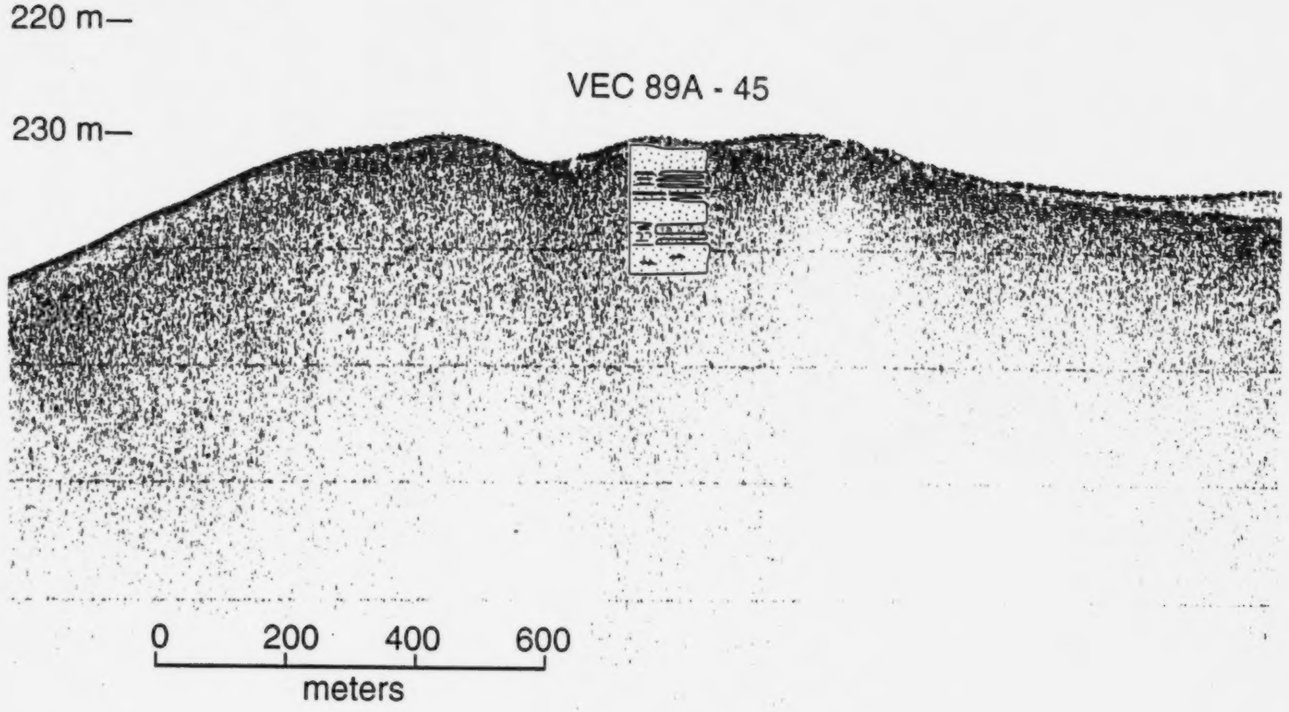

220 m—
230 m—
VEC 89A - 45
0
200
400
600
meters

Figure 5-9 Morphologic expression and internal seismic structure of the Roberts Bank depositional lobe at piston core site VEC89A-45. Note the presence of constructional channel on the lobe surface.

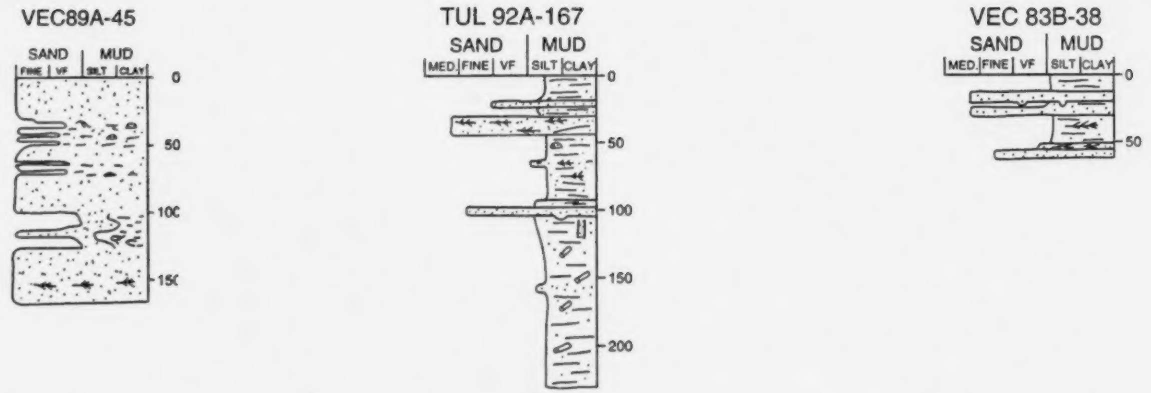

VEC89A-45
SAND
MUD
FINE
VF
SILT
CLAY
0
50
100
150
TUL 92A-167
SAND
MUD
MED.
FINE
VF
SILT
CLAY
0
50
100
150
200
VEC 83B-38
SAND
MUD
MED.
FINE
VF
SILT
CLAY
0
50

Figure 5-10. Sedimentologic logs for core collected from the Roberts Bank depositioanal lobe and lobe fringe, location on Figure 5-2A.
A). VEC89A-45 on main depostional lobe.
B). TUL92A-167 on the lobe margin.
C). VEC83B-38 on the lobe margin.

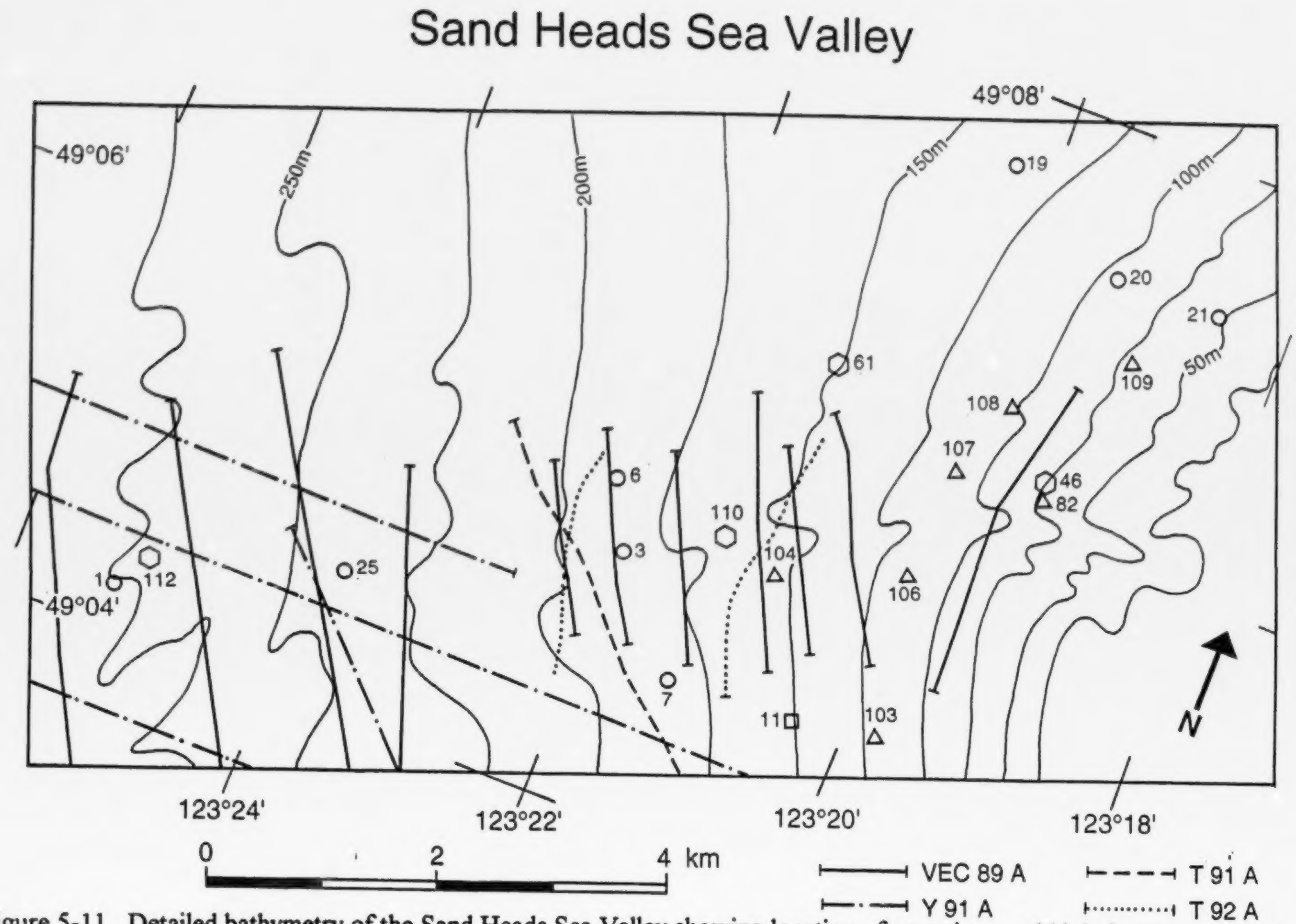

Sand Heads Sea Valley
49°08'
49°06'
49°04'
123°24'
123°22'
123°20'
123°18'
250m
200m
150m
100m
50m
19
20
21
109
108
107
46
82
61
6
3
110
104
106
103
7
11
1
112
25
N
0
2
4 km
VEC 89 A
Y 91 A
T 91 A
T 92 A

Figure 5-11. Detailed bathymetry of the Sand Heads Sea Valley showing location of core sites, and high-frequency seismic line traces. See Figure 5-1 for location.

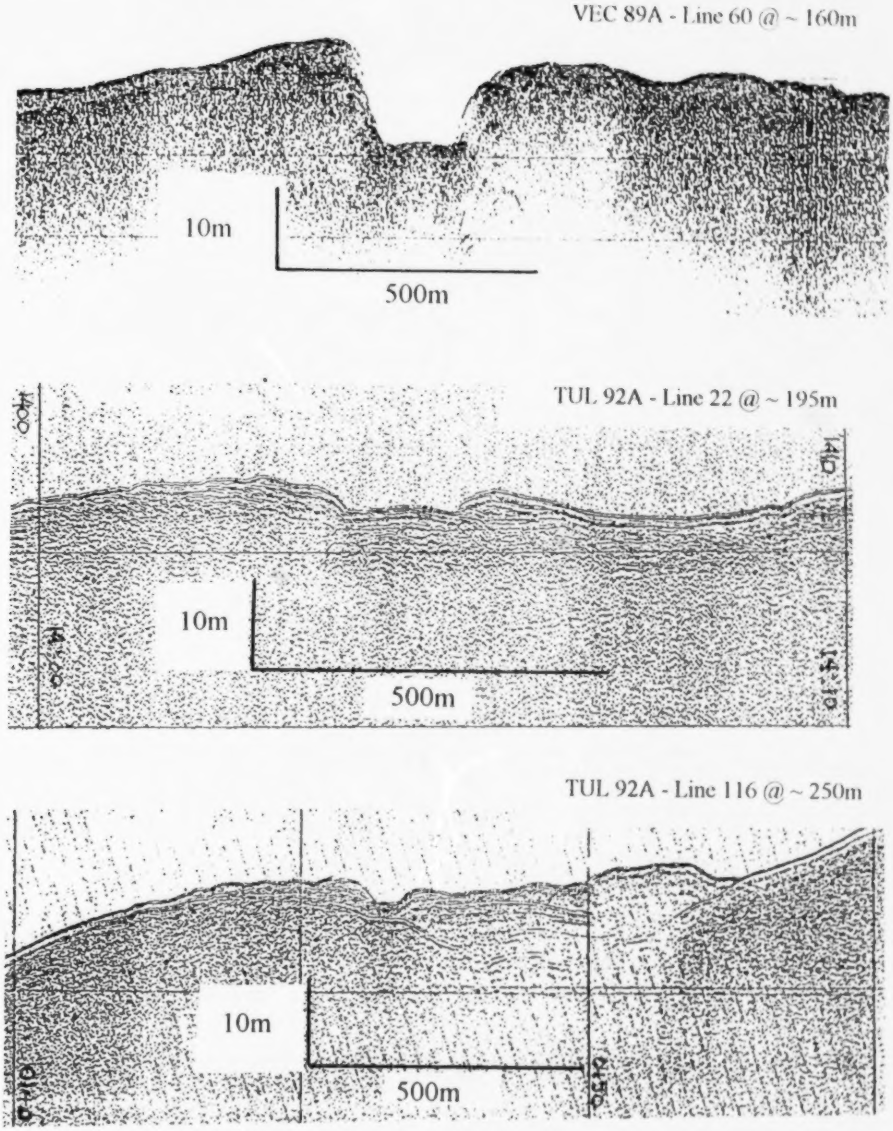


Figure 5-12. High resolution seismic line traces across the Sand Heads Sea Valley and its depositional lobe.

A). Line VEC89A-60 in the middle foreslope exhibits steep, erosional valley walls with some slumping along the southeast wall.

B). Line TUL92A-22 is from the lower foreslope. The channel here is much shallower, with better developed levees.

C). Line TUL92A-116 shows a large, poorly-defined depositional lobe with a prominent distributary channel. Apparent dip into the basin at the end of the line reflects a change in the survey orientation.

within the channel becomes more subdued downslope, reflecting increased deposition in the lower foreslope (Figure 5-12b). The main channel then bifurcates into a number of distributary channels (Kostaschuk *et al.*, 1992) which form a crudely defined depositional lobe (Figure 5-12c).

Due to the combination of strong surface currents associated with fluvial discharge, and the demands of maritime traffic for an unobstructed approach to the main navigation channel, no piston cores have been successfully obtained from within the axis of the main channel of the Sand Heads Sea Valley. However, a number of cores have been collected from the flanks of the main channel and the immediate overbank vicinity (Figure 5-11). Piston cores along the margins of the channel consist of massive to crudely bedded fine- to medium-grained sands variably interbedded with clayey to sandy silts, and containing minor rafted organic material (Figure 5-13). Individual bed thicknesses range from less than 10 cm to greater than 1 m (Figures 5-13a, 5-13b).

Piston core VEC89A-03 is representative of channel margin sedimentation along the main channel, and was recovered from the flank of the Sand Heads Sea Valley on the lower foreslope. The core is composed entirely of a amalgamated, normally graded beds that form a well developed channel sequence that coarsens and thickens up (Figure 5-13b). Deposition is from traction at the base of channelized turbidity currents.

The depositional lobe at the base of the Sand Heads Sea Valley consists of clean, upper fine- to medium-grained sands. The sands are massive, but are capped with 20 cm of well bedded silty sand and mud lamina (Figure 5-13c), the core is therefore considered to be undisturbed. The lack of internal sedimentary structures likely reflects a uniformity of grain size, and lack of a fine-grained component in the sediment. Subsamples collected from VEC89A-25 for grain size analysis contain approximately 0.5% to 1.5% combined silt and clay.

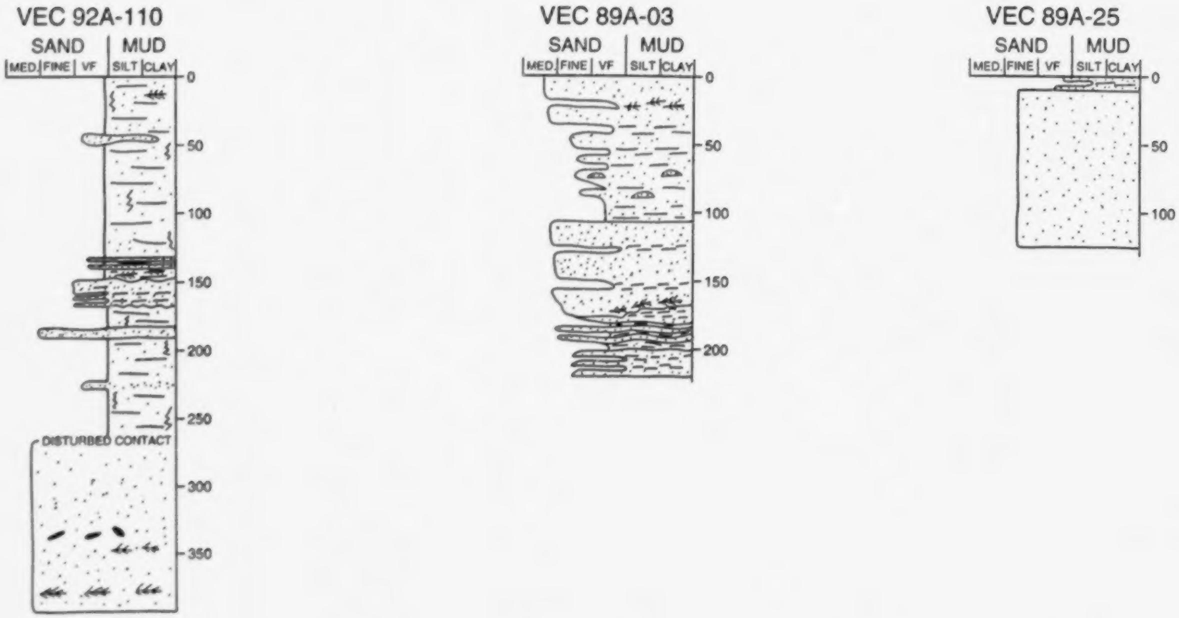

VEC 92A-110
SAND
MUD
MED
FINE
VF
SILT
CLAY
0
50
100
150
200
250
300
350
DISTURBED CONTACT
VEC 89A-03
SAND
MUD
MED
FINE
VF
SILT
CLAY
0
50
100
150
200
VEC 89A-25
SAND
MUD
MED
FINE
VF
SILT
CLAY
0
50
100

Figure 5-13. Sedimentologic logs for piston cores collected along the trend of the Sand Heads Sea Valley, locations on Figure 5-2A.
A). VEC92A-110 from the middle foreslope at 151 m.
B). VEC89A-03 from the lower foreslope at 190 m.
C). VEC89A-25 from the base of the foreslope at 240 m.

Overbank sediments proximal to the main channel consist of clayey silts with minor thin bedded very fine- to fine-grained sands. The silts contain variable organic material and rare shell fragments (Figures 5-14a, 5-14b), and exhibit minor burrowing. Sand interbeds are typically less than 5 cm thick and exhibit abrupt upper and lower contacts, or rare erosive bases (Figure 5-14a). Piston core VEC89A-06, 800 m north of site VEC89A-03 on the levee of the Sand Heads Sea Valley, represents a weakly defined fining upwards sequence with finely laminated silty muds and minor thin-bedded turbidites overlain by massive appearing muds (Figure 5-14c). Depositional processes are interpreted to represent channel overbank or inter-channel flow by dilute, unconfined turbidity currents and concurrent background deposition of silts and clay from suspension fallout.

### *Lateral Facies Variability*

The incision, or construction, of multiple channels through time on the delta foreslope has resulted in a high degree of lateral facies variability. The significance of these channels in the development of the geometry and internal architecture of the delta front is apparent on depositional strike sections. Section A-A', from south of the Roberts Bank Channel to north of the Sand Heads Sea Valley, shows the importance of coarse-grained siliciclastic material in the depositional framework of the lower foreslope. All cores on this section are from water depths between 150 and 190 m (Figure 5-15). All but two of these cores contain some fine- to medium-grained sand beds, and sands are a significant component of the total recovered sediment (>30%).

Cores collected from south of the Roberts Bank Channel show evidence of older abandoned channels in the framework of the lower foreslope. Given the lack of available data, definitive internal correlations are not possible. The Roberts Bank Channel is the only area where coring density is adequate to correlate between sites, and shows the role of channel migration in the delivery and deposition of sands. The fine-grained sand in the upper 45 centimetres of PAR91A-20 is a product of the migration of large sandwaves (3 m high by 100 m wavelength) across the upper Roberts Bank foreslope (Kostaschuk and Luternauer, 1993).

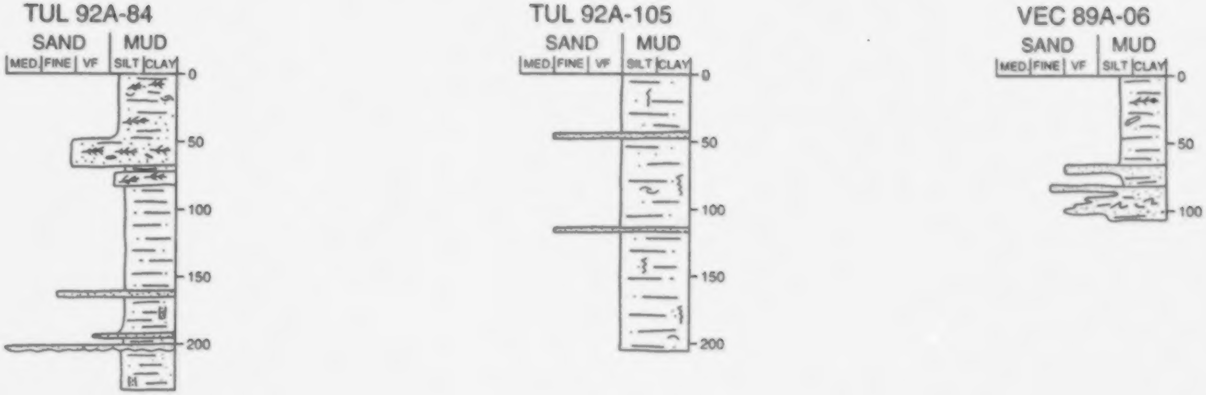
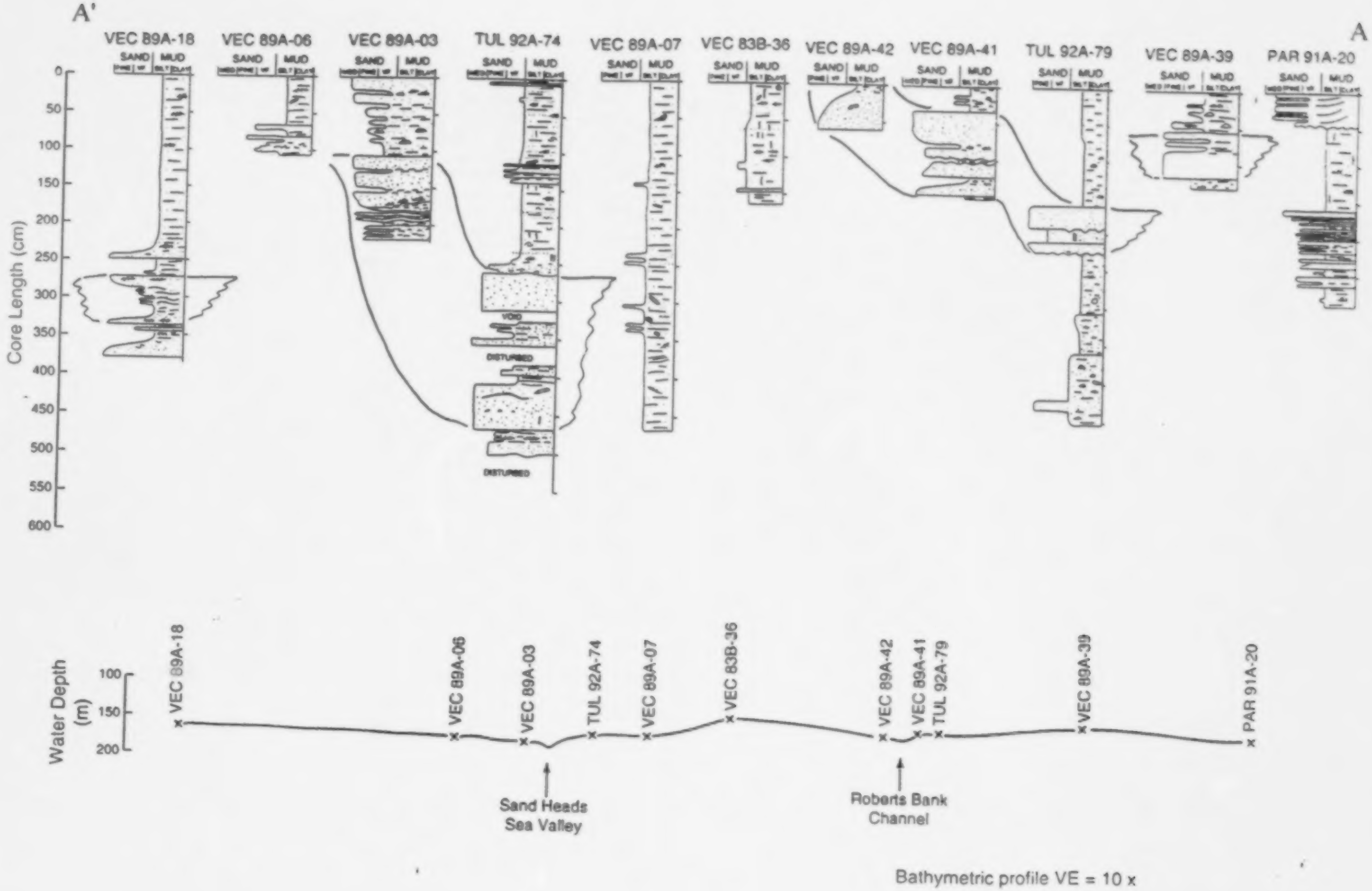

TUL 92A-84
SAND
MUD
MED
FINE
VF
SILT
CLAY
0
50
100
150
200
TUL 92A-105
SAND
MUD
MED
FINE
VF
SILT
CLAY
0
50
100
150
200
VEC 89A-06
SAND
MUD
MED
FINE
VF
SILT
CLAY
0
50
100

Figure 5-14. Sedimentologic logs for piston cores from levee and overbank environments proximal to the Sand Heads Sea Valley. See Figure 5-2A for locations.

A). TUL92A-84 from the middle foreslope north of the main channel.
B). TUL92A-105 from the middle foreslope south of the main channel.
C). VEC89A-06 from the lower foreslope north of the main channel.



A'
A
VEC 89A-18
VEC 89A-06
VEC 89A-03
TUL 92A-74
VEC 89A-07
VEC 83B-36
VEC 89A-42
VEC 89A-41
TUL 92A-79
VEC 89A-39
PAR 91A-20
SAND
MUD
VOID
DISTURBED
Core Length (cm)
0
50
100
150
200
250
300
350
400
450
500
550
600
Water Depth (m)
100
150
200
Sand Heads Sea Valley
Roberts Bank Channel
Bathymetric profile VE = 10 x

Figure 5-15. Strike section across the lower foreslope on Roberts Bank detailing lateral facies variability at approximately 180m. Note the preponderance of Facies 4 sands. Line of section denoted as A - A' on Figure 5-2A.

Although there is no evident sand source, these sandwaves are likely related to the erosion and retreat of the southern portion of Roberts Bank (Luternauer *et al.*, **in press**).

The interchannel environment between the Roberts Bank Channel and the Sand Heads Sea Valley consists primarily of silty muds deposited from suspension, with minor deposition of sand from the entrained layer of unconfined turbidity currents (Figure 5-15). Rare *Paleophycus* burrows are associated with thin sand intervals. Rafted organics and wood fragments, both disseminated and bedded, are present in the non-bioturbated intervals.

Channel-fill thickness in the Sand Heads Sea Valley is unconstrained, but exceeds a minimum of 3 m (see also Figure 5-13a). The basal 50 cm of TUL92A-74 was badly disturbed during transport or storage, and consists of admixed fine- to very fine-grained sand and silt. Neither VEC89A-03 nor VEC92A-110 penetrated the base of the channel fill. The presence of older channel-fill sequences on either side of the active channel suggests that deposition occurs from a series of meandering channels within the main valley. This supports the interpretation of channel sinuosity as a function of channelized flow (Kostaschuk *et al.*, 1992) as opposed to being an artifact of slumping.

The channel shown at the north end of section A-A' is speculative. Most of the sand beds present in piston core VEC89A-18 are discrete turbidites with sharp bases, well defined fining upwards profiles, and well developed Bouma $T_{a-e}$ or $T_{b-e}$ subdivisions. The interval at approximately 300 cm thickens and coarsens upwards, and may represent an older, small-scale foreslope channel.

## Discussion

### *Sand Distribution: Process Implications*

The coarsest-grained, best sorted sediments documented in the subaqueous delta are associated with the Roberts Bank Channel and its depositional lobe, and the lower portion of the Sand Heads Sea Valley (Evoy *et al.*, 1994). Spatially, most channel sands are located along the axial trend of the two main channels crossing the foreslope, with massive, thick-bedded, high-density turbidites restricted to the locus of deposition at the base of these channels (Figure 5-16).

This distribution shows that the down-slope mass transfer of the coarser-grained sizes (fine- to medium-grained sand) is limited to the main channel systems and the aerially greatest sand accumulations are at the base of the foreslope. The upper and middle foreslope are areas of near complete bypassing by the coarser sediment fractions. Furthermore, the depositional lobe deposited at the base of the Roberts Bank Channel contains less clay, is better sorted, and is coarser grained than any of its correlative upslope cores.

Sediment distribution patterns and textural parameters can be used to constrain the depositional processes active in sand bypassing. Turbidity currents play a significant, and probably dominant, role in the formation and maintainance of submarine channels on the Fraser River delta foreslope. The mechanism of failure at Sand Heads has been interpreted as retrogressive slope failure (McKenna *et al.*, 1992), probably due to rapid deposition and large tidal draw-down at the river mouth (Kostaschuk *et al.*, 1989b). The resultant liquified flows transform into turbidity currents via flow acceleration.

While debris flows may also be assumed to be a significant element in the mass transfer of sediment from the subaerial delta into deep water, the degree to which they are active is poorly constrained in the Fraser delta. Much of the data cited to support recent debris flows are based on: (1) the documentation of large scale failures in the vicinity of Sand Heads, (2) the surface morphology of areas that have not been successfully cored, and (3) the absence of recognizable sedimentary structures in massive appearing sands (Hart *et al.*, 1992a). As previously stated, the Sand Heads Sea Valley has been fixed and modified by dredging and jetty construction, and may not be representative of the historic delta. The presence of massive-appearing sand intervals as a quick bed is common in many turbidites,

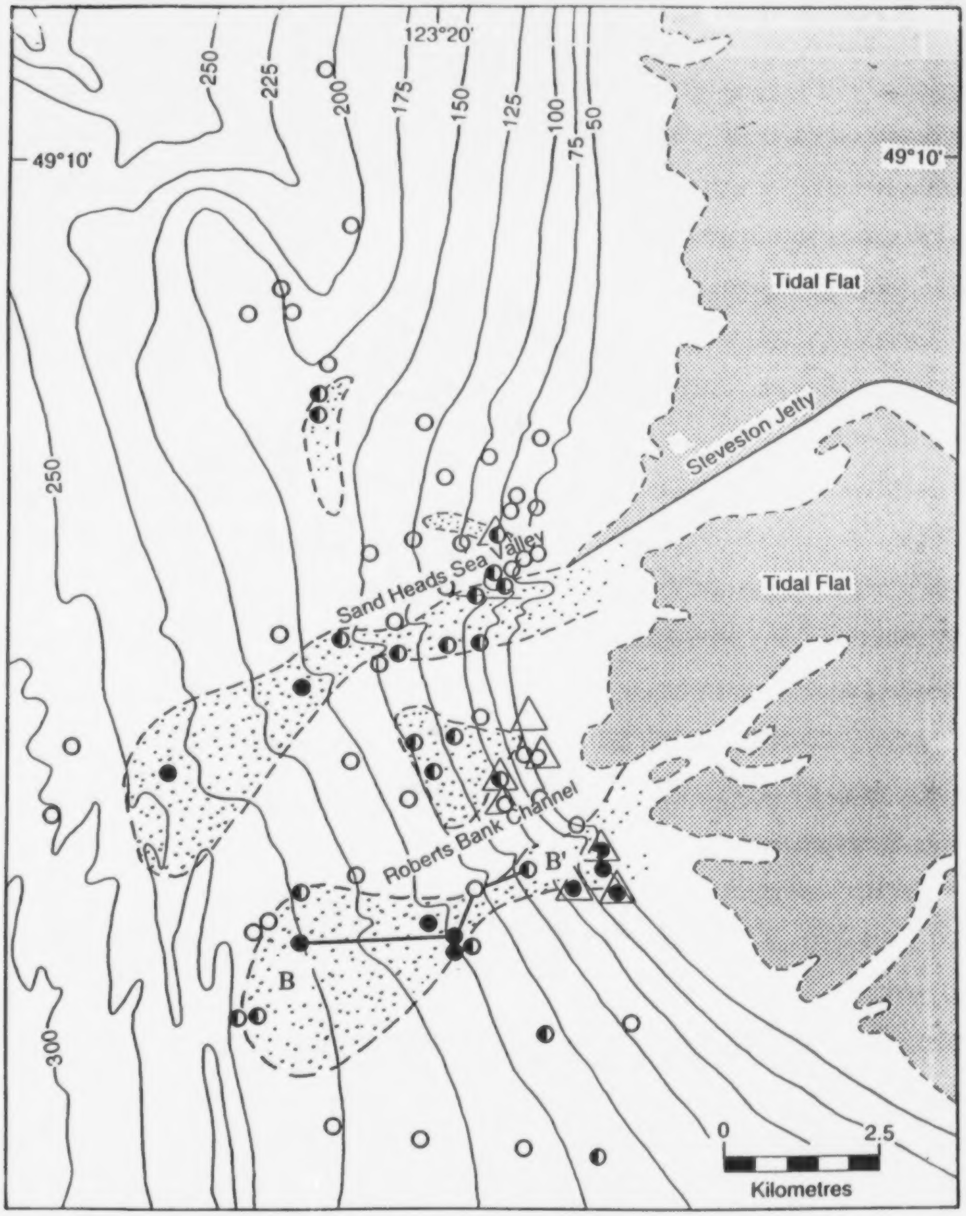

123°20'
250
225
200
175
150
125
100
75
50
49°10'
49°10'
Tidal Flat
Steveston Jetty
Sand Heads Sea Valley
Tidal Flat
250
Roberts Bank Channel
B'
B
300
0
2.5
Kilometres

Figure 5-16. Plan view of sand distribution across the study area. The outline of the Facies 4 assemblage (stippled), highlights the degree of sediment bypassing of the foreslope by coarser grain sizes. Symbols as on Figure 3-7.

and should be expected to be exaggerated by coring-induced liquifaction.

It was shown in Chapter 3 that greater than 50% of the clay size fraction in Facies 4 sands consists of siliciclastic debris. Facies 4C sands typically contain less than 1% clay size material, and are thus estimated to contain less than 0.5% clay minerals. Hampton (1975) calculated that a subaqueous debris flow strong enough to carry fine sand requires 4% clay minerals in the matrix, which represents approximately 2% clay minerals in the final deposit. This is based on the assumption of pure Kaolin clays; the presence of other clay mineral species would be expected to increase the matrix competence (Hampton, 1970). Many Facies 4 sands, and all Facies 4C, appear to contain insufficient clay mineral contents to have provided cohesive strength during transport.

### *Implications of Channel Type for Deposition of Deep Water Sands*

Inception of sedimentation in the Fraser River delta at the beginning of Holocene time was coupled with an isostatically driven fall of local sea level of about 200 m (Mathews *et al.*, 1970; Clague *et al.*, 1982). The ensuing transgression during the subsequent 8000 years is on the order of 12 to 13 m (Clague *et al.*, 1982; Williams and Roberts, 1989). Most of this transgression occured rapidly, with sea level rising to within a few metres of its present level by about 6200 years ago, and stabilizing at its present level *circa* 2250 BP (Williams and Roberts, 1989).

During this period of relative sea level rise, the delta experienced only minor local transgression, and underwent continual progradation of approximately 16.25 km, and vertical accretion. Rates of vertical accretion accelerated dramatically, coincident with the rate of sea level rise, as a function of increasing accomodation space. This unique geographic setting, and the presence of sand-sized clastic detritus being introduced directly into water depths in excess of 200 m, may serve as an analogue to lowstand (shelf-edge) deltas.

The Roberts Bank Channel is currently inactive and is believed to predate any appreciable anthropogenic mediation. The channel is constructional in nature with well develped depositional levees (Figure 5-8), and lacks any evidence of either erosional downcutting or its fluvial origin. Much of the coarsest sediment supplied to the head of the channel bypasses the delta plain and upper foreslope to be introduced directly to the lower foreslope and basin floor. Sediment transport in the channel is via turbidity currents, and deposition is in the form of a small well-developed lobe, or submarine fan (Figures 5-6c, 5-9).

The resultant sand body geometry in cross-section produces a wedge which both thickens and coarsens down slope (Figure 5-17). Documented channel-fill sand thicknesses on the Roberts Bank lower foreslope do not exceed 2.5 m, and are characterized by numerous silty laminae. Down slope, the Roberts Bank depositional lobe contains fewer silty laminae, less fine-grained matrix within individual beds, and is estimated to be 10 m thick. Up slope, the channel sands thin and pinch out into the finer-grained sediments (silts and clay) of the middle foreslope bypass zone.

The sand depocentre and maximum sand thickness occurs at the base of the foreslope where turbidity currents become unconfined and deposit their bedload. In conjunction with upslope channel migration (Figures 5-8, 5-15) the depocentre can be expected to migrate. Through time, this will produce a series of linear sand bodies oriented subparallel to bathymetry (Figure 5-18; Time 1 through Time 4). Amalgamation of these sands should ultimately result in a single elongate, strike-parallel sand wedge resting conformably on deep-water muds (Figure 5-18; Time 5 and 6). In the subaqueous Fraser River delta, this process has been arrested by construction of the Steveston Jetty and anthropogenic stabilization of the distributary channels.

The position and nature of the Sand Heads Sea Valley is strongly controlled by anthropogenic modification. The main channel of the Sand Heads Sea Valley in the middle and lower delta foreslope is several hundred metres wide, and up to 18 m deep. The channel walls are steep, markedly erosional, and capped by crude depositional levees. While much of

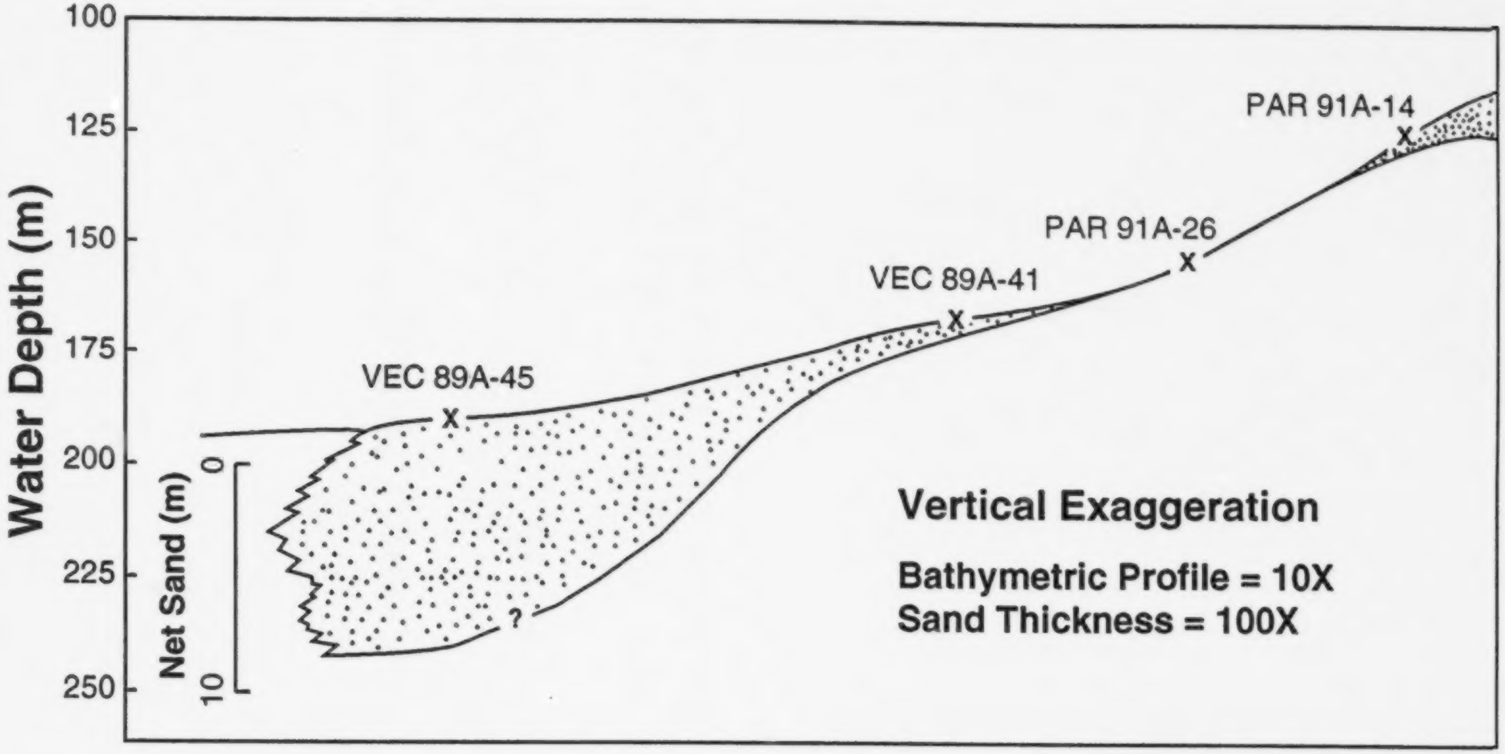

Water Depth (m)
100
125
150
175
200
225
250
Net Sand (m)
0
10
VEC 89A-45
VEC 89A-41
PAR 91A-26
PAR 91A-14
X
?
Vertical Exaggeration
Bathymetric Profile = 10X
Sand Thickness = 100X

Figure 5-17. Sand bypassing model and wedge geometry redrawn from Figure 5-7. Line of section denoted as B - B' on Figure 5-2a.

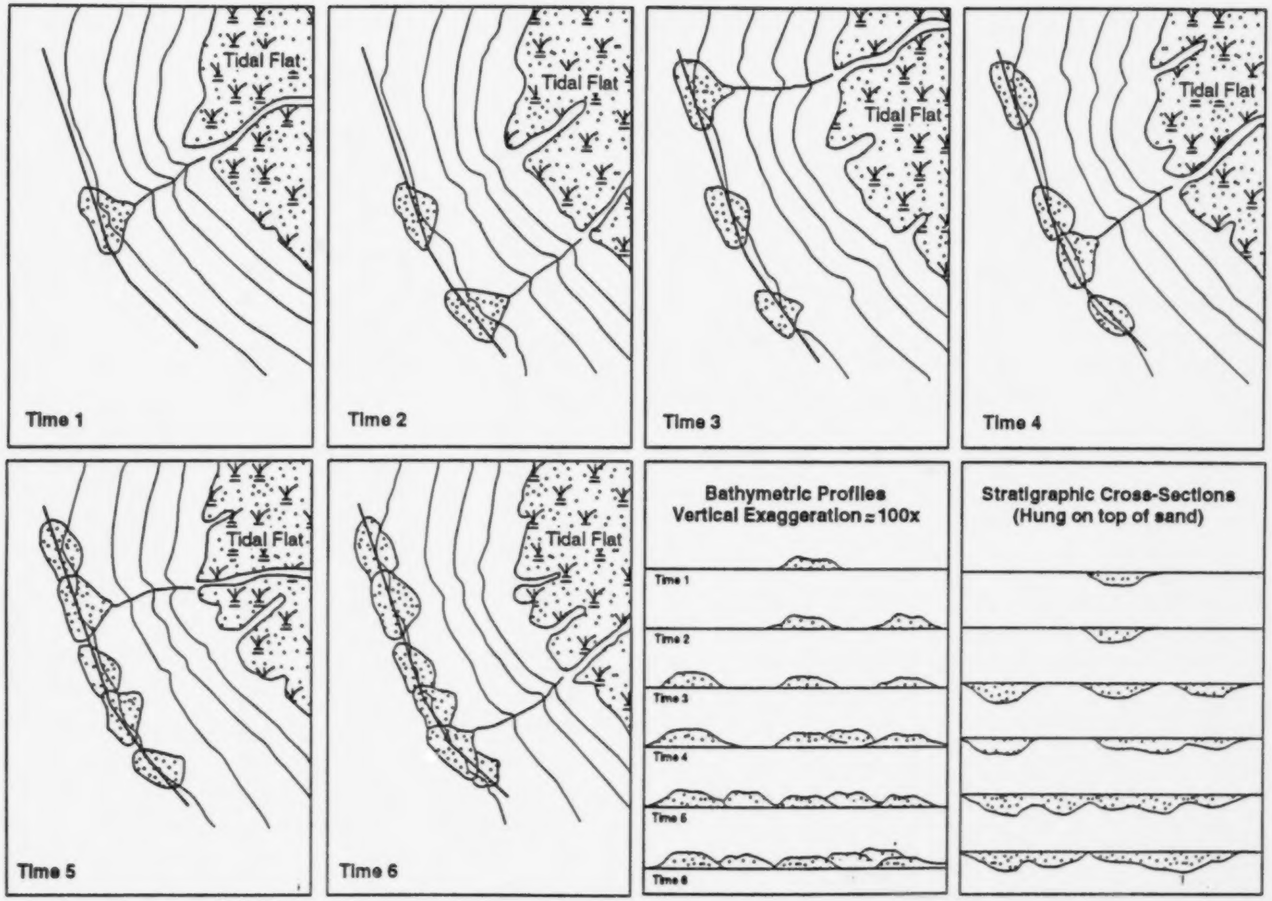

Tidal Flat
Time 1
Tidal Flat
Time 2
Tidal Flat
Time 3
Tidal Flat
Time 4
Tidal Flat
Time 5
Tidal Flat
Time 6
Bathymetric Profiles
Vertical Exaggeration ≈ 100x
Time 1
Time 2
Time 3
Time 4
Time 5
Time 6
Stratigraphic Cross-Sections
(Hung on top of sand)

Figure 5-18. Time sequence diagram showing model for development of linear sand bodies at the base of the subaqueous delta foreslope.

the sediment supplied to the lower foreslope from the tidal flats is via turbidity currents, the significance of debris flows in the mass transfer of sediment is arguably much greater in the Sand Heads Sea Valley than it is in the Roberts Bank Channel (Hart *et al.*, 1992a; 1992b).

Unlike the Roberts Bank Channel, channel migration in the Sand Heads Sea Valley is restricted within the confines of the main valley. Sand deposition within the channel should be similarily controlled by the valley geometry. Over time, these restrictions should produce an erosional valley incised subaqueously into deep water muds, and subsequently filled with coarser sediment. Although superficially similar to an incised valley, both incision and deposition occur during the early phase of a single transgressive event. Facies on either side of the erosional surface are genetically related, and the actual sequence boundary is at the base of the deltaic section.

The implications of a fixed valley system for the development of the depositional lobe at the base of the valley is problematic. The Sand Heads Sea Valley depositional lobe is less well defined than the Roberts Bank depositional lobe, and is subject to sediment failure and remobilization. This results in a greater down dip displacement of sediment than occurs in the Roberts Bank Channel. Through time, a large submarine fan elongate in a dip direction should be anticipated, as opposed to the strike parallel wedge geometry expected from ephemeral channels.

## Summary and Conclusions

The Fraser River delta foreslope is bisected by two pronounced bathymetric channels, or "sea valleys". These channels are initiated and maintained by sediment gravity flow processes related to periodic liquifaction and failure at the head of the foreslope (McKenna *et al*, 1992; Kostashuk *et al.*, 1992; Hart *et al.*, 1992a).

The two main channels on the subaqueous delta exhibit significantly different characteristics. The Roberts Bank Channel is currently inactive and represents an ephemeral feature on the delta foreslope. The channel is constructional with well developed depositional levees. The position of the Sand Heads Sea Valley has been culturally fixed by jetty construction. The channel is erosional, with steep valley walls marked by truncation of parallel reflectors and erosional undercutting.

Much of the coarsest sediment supplied to the mouth of the delta bypasses the delta plain and upper foreslope and is introduced directly to the lower foreslope and basin floor. These channels debouche onto the basin floor to produce a series of sand-rich depositional lobes (Moslow *et al.*, 1991; Evoy *et al.*, 1993b), and small slump-bound turbidite basins (Hamilton and Wigen, 1987; Hart *et al.*, 1992b).

The incision of multiple channels through time on the Fraser River delta foreslope has resulted in a high degree of along-slope lateral facies variability. Upslope migration and abandonment of ephemeral channels results in the deposition of a strike parallel sand wedge (slope apron) formed by the coalesence of a number of small submarine fans at the base of the foreslope. Deposition from a fixed channel (point source) should be anticipated to result in the construction of an elongate submarine fan normal to depositional strike and bathymetry. Channelized turbidity current, and possible debris flow transport of coarse sediment across the relatively steep (3°) slope ("sand bypassing") into water depths ≥250 m provides a promising process sedimentologic analogue for identification and reconstruction of shelf-edge deltaic facies and lowstand wedges from the geologic record.

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# CHAPTER 6.

# LITHOFACIES ASSOCIATIONS AND DEPOSITIONAL ENVIRONMENTS IN THE MIDDLE TRIASSIC DOIG FORMATION, BUICK CREEK FIELD, NORTHEASTERN BRITISH COLUMBIA. [5]

## Introduction

### *General*

Recent gas resource assessments for the Western Canada Sedimentary Basin suggest that one-half (51%) of Triassic gas reserves remain undiscovered (Bird *et al.*, 1994). The most promising play within this interval is the "Halfway/Doig-Shelf" in northeastern British Columbia, with estimated reserves of approximately 4 TCF initial in-place volume. This play can be subdivided into a southern portion along the northern flank of the Peace River Arch, with an estimated one third of the total remaining potential (approximately 3.1 TCF), and an additional 0.8 TCF present in this play further north away from the main influence of the Peace River Arch.

Most emphasis on this play has focussed on the Halfway Formation. To date, no major study of a Doig reservoir within this area has been attempted. This study characterizes a significant Doig field in the area by documenting facies associations and inferred depositional processes as determined from cores and wireline logs. This characterization has allowed for the construction of a depositional model within a sequence stratigraphic framework which can be used as a possible exploration "template" for future development.

### *Buick Creek Field*

The Buick Creek Field in northeastern British Columbia (Figure 6-1) represents the largest recognized Doig reservoir in the Fort St. John area. Since the discovery of the Doig B pool in 1976, a total of 5 oil pools (2 with economic associated gas) have been discovered.

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[5] A version of this chapter has been accepted for publication. Evoy, R.W. and Moslow, T.F., *in press*. *Bulletin of Canadian Petroleum Geology*, December, 1995.

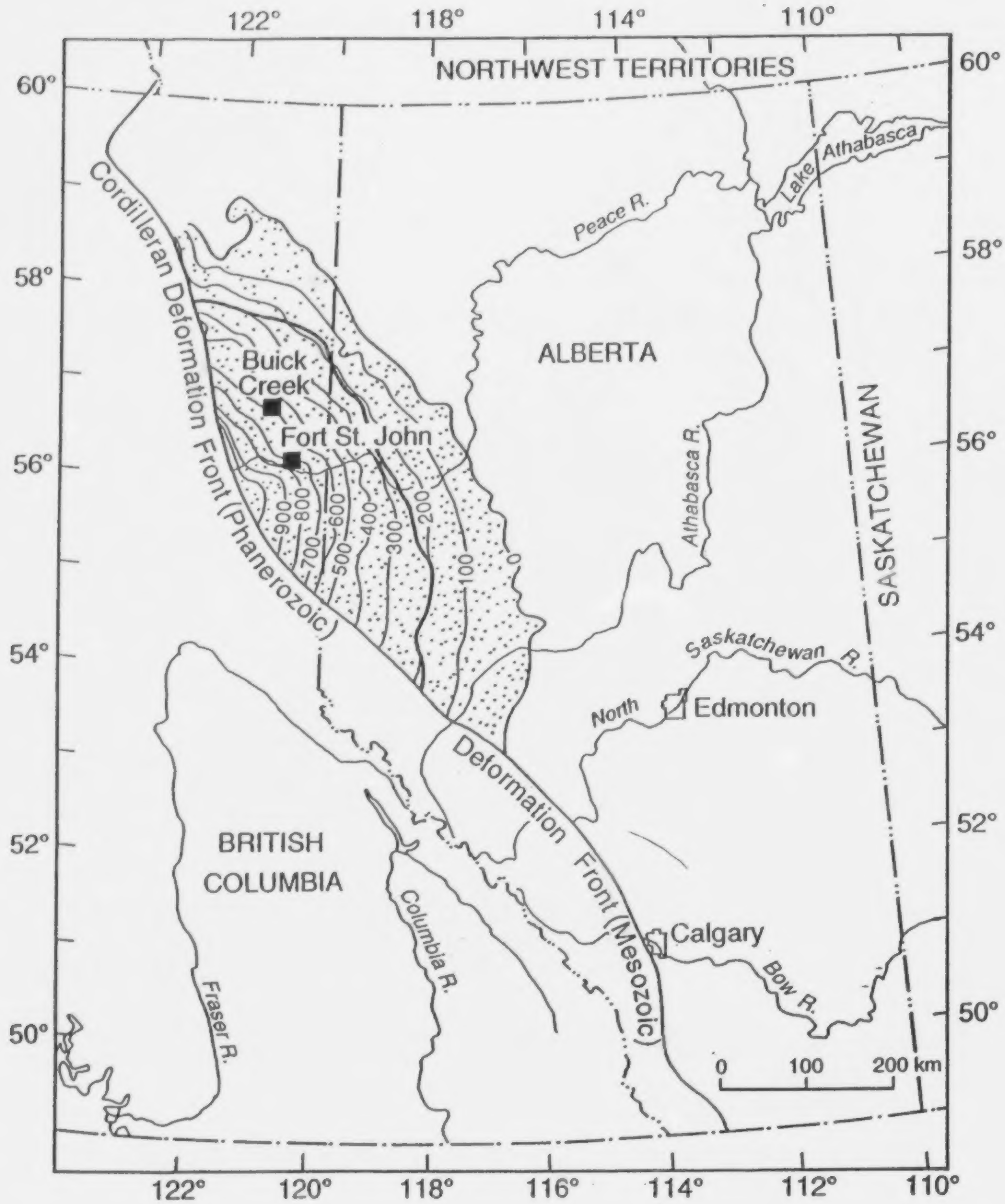

122°
118°
114°
110°
60°
58°
56°
54°
52°
50°
120°
116°
112°
NORTHWEST TERRITORIES
Cordilleran Deformation Front (Phanerozoic)
Deformation Front (Mesozoic)
Buick Creek
Fort St. John
900
800
700
600
500
400
300
200
100
0
Peace R.
Lake Athabasca
ALBERTA
Athabasca R.
SASKATCHEWAN
North Saskatchewan R.
Edmonton
BRITISH COLUMBIA
Columbia R.
Fraser R.
Calgary
Bow R.
0
100
200 km

Figure 6-1. General location map for the Buick Creek Field area, with total Triassic isopach values overlain. Heavy line approximating the 200 metre contour represents the erosional edge of the Halfway-Doig interval. (After Edwards *et al.*, 1994).

Initial in-place volumes exceed 20 million bbls oil with 12.5 bcf gas (Table 6-1). Differentiation of these pools is based on production characteristics, not stratigraphic discontinuities. Average net oil pay is approximately 7 m with porosities about 10%. Average gas pay and porosity is approximately 4 m and 8.5%. Water saturation levels are low, and the oil is a light crude (Table 6-1).

A total of 51 wells penetrate the Halfway/Doig interval in the immediate Buick Creek field area (Figure 6-2), and provides the greatest database available for subsurface reconstruction of a Doig pool. Twenty two of these wells have been cored, including at least one well in each pool. All available core has been logged (550 m).

### *Stratigraphy*

Middle Triassic strata of northeastern British Columbia represent a progradational sequence of marine to shallow marine clastic sediments deposited on the western flank of the North American craton (Gibson and Barclay, 1989). These strata unconformably overlie the lower Triassic Montney Formation, and are abruptly overlain by marginal marine to non-marine clastics, evaporites and carbonates of the Charlie Lake Formation.

In the subsurface, middle Triassic strata are subdivided into two broad lithostratigraphic units (Table 6-2). The Doig Formation consists of phosphatic marine shales, siltstone and minor sandstone (Armitage, 1962), and is transitional upsection into the shallow marine sandstones and coquinas attributed to the Halfway Formation (Hunt and Ratcliffe, 1959). The contact between the two formations, in practical usage, has been defined on the basis of the slightly more radioactive gamma ray log signature of the Doig Formation (Dawes, 1990), or placed at the top of the first significant shale interval below the Halfway sandstone (Edwards *et al.*, 1994). The contact has alternatively been described as a disconformity marked by a thin lag of dolomite, quartz and chert-granule conglomerate (Dawes, 1990) or, locally, an unconformity (Chunta, 1969; Cambell and Horne, 1986), while others argue that this lag simply represents basal scour within tidal inlet channels (Willis, 1992; Caplan, 1993).

Table 6-1. Summary of reservoir production characteristics for all Doig/Lower Halfway pools in the Buick Creek Field.

## Buick Creek

### RESERVOIR SUMMARY - DOIG/LOWER HALFWAY POOLS

| | |
|---|---|
| **General** | |
| **Location** | I/94-A-11 and A/94-A-14 - 55km north-northwest of Fort St. John, B.C.. |
| **Tectonics** | Ramp type passive margin<br>North flank Fort St. John and Dawson Creek grabens, and Hay River Fault Zone. |
| **Trap Mechanism** | Stratigraphic - overlying deep marine silts and muds. |
| **Source Rock** | Presumed Doig Phosphate Zone source. |
| **Reservoir Rocks** | |
| **Age** | Middle Traissic - Anisian/Ladinian? |
| **Stratigraphic Unit** | Doig - 1st Sand Equivalent. |
| **Lithology** | Sandstone - Fine grain. |
| **Dep. Environment(s)** | Probable lower-middle shoreface - lowstand systems tract/incised shoreface. |
| **Productive Facies** | Sands preserved within shoreface following subsequent transgressive erosion. |

| | OIL | GAS |
|---|---|---|
| **Reservoir Characteristics (1)** | (5 pools) | (2 pools) |
| **Net Pay (Average)** | ~ 7m | ~ 4m |
| **Net Pay (Range)** | 6.2m - 21.4m | 3.2m - 4.3m |
| **Petrophysics** | | |
| **Porosity** | ~ 10% | ~ 8.5% |
| **Porosity Range** | 9.4% - 10.4% | 7.3% - 9.1% |
| **Depth** | | |
| **Thickness (2)** | | |
| **Total Area (all pools)** | 444ha | 252ha |
| **Fluid Data (1)** | | |
| **Saturation** | < 10% | < 15% |
| **API Gravity (Range)** | 42.8 - 45.2 | 43.5 |
| **Gas-Oil Ratio** | < 160 | |
| **Production Data (3)** | | |
| **Type** | OIL | GAS |
| **In Place Volume** | 20,791,742 bbls | 12.6 bcf |
| **Cumm. Production** | 1,145,308 bbls | 9.1 bcf |
| **Est. Reserves** | 2,310,753 bbls | 1.7 bcf |
| **Recovery Factor** | 10% - 20% | 90% |

### COMMENTS

1 Average characteristics estimated based on all pools (5 oil, 2 gas).

2 Sand thickness based on 60 API cut-off.

3 Cummulative data based on sum of all pools.

Cores available in all pools. All discovery wells except a-67-I (Doig B Pool) cored: 22 total cored wells in field area.

Data source: Hydrocarbon and By-Product Reserves in British Columbia - 1993.

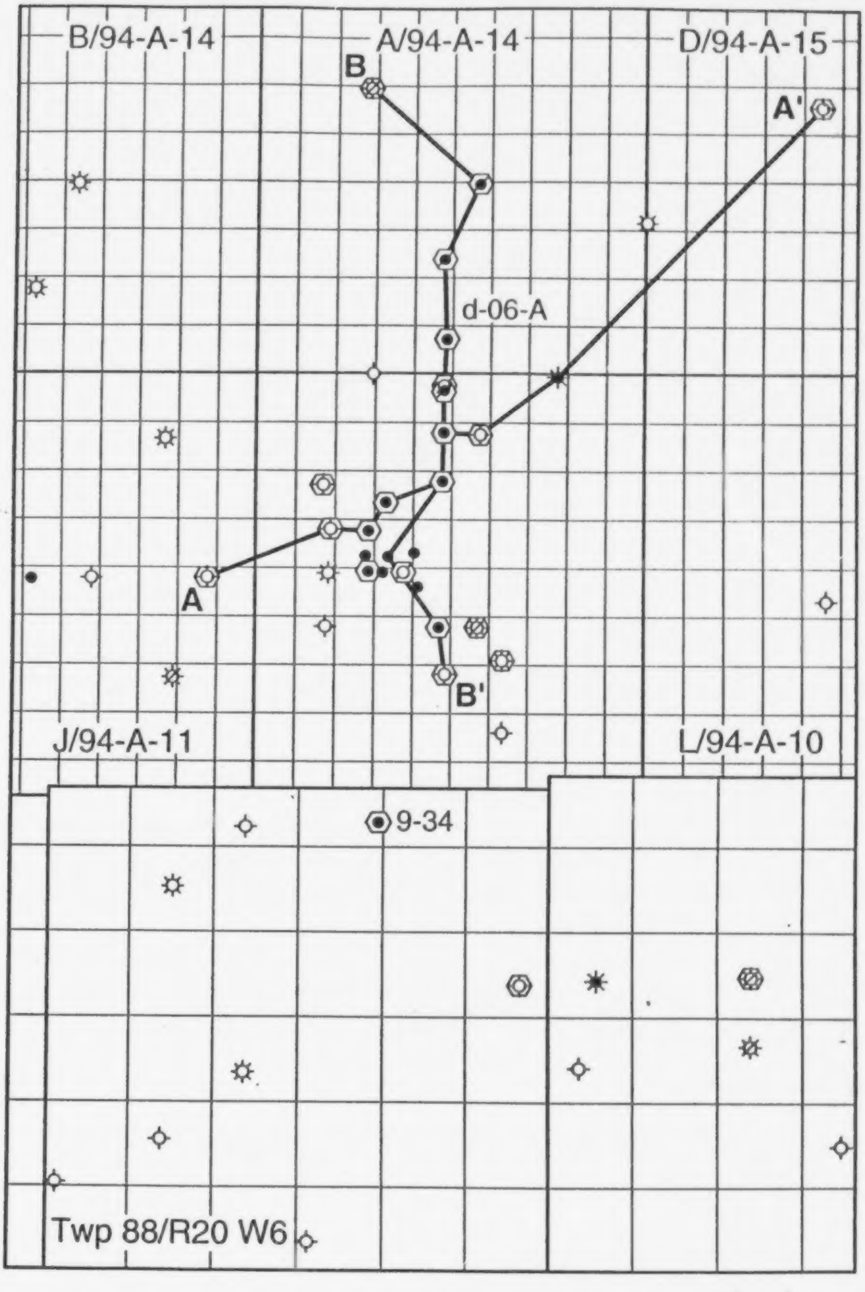

B/94-A-14
A/94-A-14
D/94-A-15
B
A'
d-06-A
A
B'
J/94-A-11
L/94-A-10
9-34
Twp 88/R20 W6
Intervals with Halfway/Doig Core
1 km

Figure 6-2. Well control in the Buick Creek Field area, showing all Halfway penetrations. Hexagons mark wells with core from the Doig Formation. Annotated wells and section lines refer to subsequent figures.

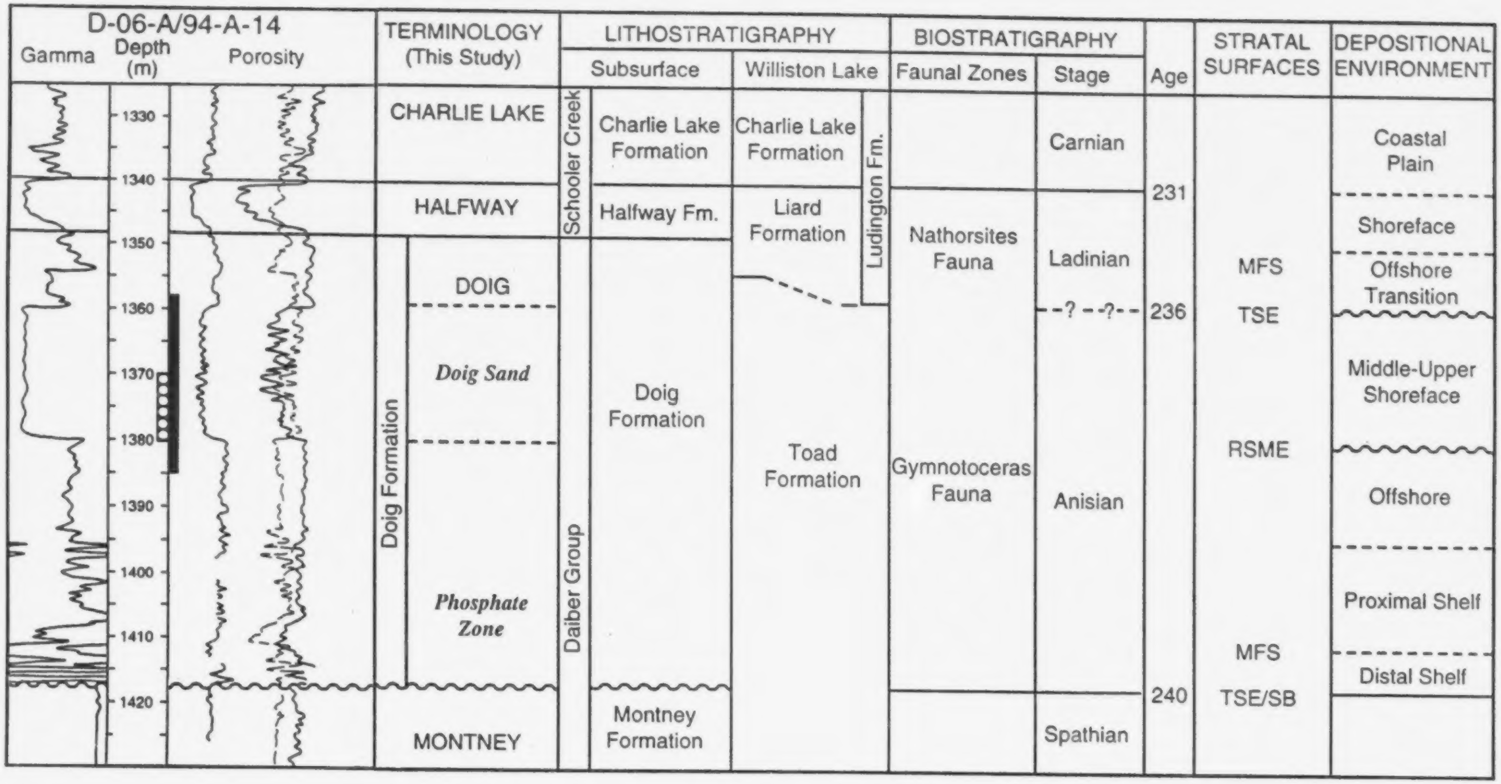

D-06-A/94-A-14
Gamma
Depth (m)
Porosity
1330
1340
1350
1360
1370
1380
1390
1400
1410
1420
TERMINOLOGY (This Study)
CHARLIE LAKE
HALFWAY
Doig Formation
DOIG
Doig Sand
Phosphate Zone
MONTNEY
LITHOSTRATIGRAPHY
Subsurface
Schooler Creek
Daiber Group
Charlie Lake Formation
Halfway Fm.
Doig Formation
Montney Formation
Williston Lake
Charlie Lake Formation
Liard Formation
Ludington Fm.
Toad Formation
BIOSTRATIGRAPHY
Faunal Zones
Nathorsites Fauna
Gymnotoceras Fauna
Stage
Carnian
Ladinian
-? --?--
Anisian
Spathian
Age
231
236
240
STRATAL SURFACES
MFS
TSE
RSME
MFS
TSE/SB
DEPOSITIONAL ENVIRONMENT
Coastal Plain
Shoreface
Offshore Transition
Middle-Upper Shoreface
Offshore
Proximal Shelf
Distal Shelf

Table 6-2. Stratigraphic correlation table for the Middle Triassic in the subsurface in northeastern British Columbia, with representative wireline log signatures from the Buick Creek Field. Location of d-06-A/94-A-14 on Figure 6-2. Lithostratigraphic terminology and stages from Gibson and Barclay (1989), faunal zones from Tozer (1961).

This contact does not appear to represent a regionally correlatable stratigraphic break (Willis, 1992; Wittenberg, 1992).

The difficulty in differentiating between the basal Halfway and Doig formations is now generally accepted (eg: Gibson and Edwards, 1990; Edwards *et al.*, 1994). The two are treated herein as a single, continuous unit (Table 6-2) which constitutes the overall progradational phase of a T-R cycle (Assemblage II of Gibson and Barclay, 1989). While the Doig is often defined as the deep water facies equivalent to the shallow marine clastics of the Halfway Formation, such usage makes the *a priori* assumption that any sandstone completely encased within the siltstones and shales of the classic Doig assemblage must therefore represent deep water sand deposition.

## Sedimentary Facies and Facies Associations

### *General*

Due to the abundance of subsurface core control in the Buick Creek Field area, all facies herein are described based on their observed physical characteristics as opposed to log signature. Four major facies types were recognized based on lithology, primary physical and biogenic sedimentary structures, bedding geometry, and the nature of their bounding surfaces. Each main facies was subdivided based on texture (percent sand, maximum clast size). A final facies class was assigned for all intervals with significant degrees of apparent soft-sediment deformation. This latter facies was included to assess the style and timing of deformation and to test for correlation between stratal disruption and depositional environment.

A total of nine sedimentary facies were thus recognized (Table 6-3). Commonly recurring groupings of lithofacies were classified together to define facies associations characteristic of gross depositional environments. Three facies associations were recognized, in ascending order: offshore/shelf, shoreface, and offshore transition.

Table 6-3. Summary of sedimentary facies characteristics in the Doig Formation, Buick Creek Field.

| FACIES | LITHOLOGY | SEDIMENTARY STRUCTURES AND BEDDING GEOMETRY[1] | DEPOSITIONAL PROCESS(ES) | DEPOSITIONAL ENVIRONMENTS[2] |
|---|---|---|---|---|
| A1 | SILTY MUD<br>black,calcareous<br><5 to 10% vfg sand | Plane parallel lamina, rare ripple lamina, discontinuous sand lamina; beds to $6m^{+}$. Pl, Pa | SUSPENSION SEDIMENTATION<br>Rare traction currents, turbidites/contourites. | OFFSHORE -<br>Distal Shelf |
| A2 | MUDDY SILT<br><10% vfg sand | Plane parallel lamina, minor ripple lamina, rare convolute beds; coarsens up; sands to 5cm thick, beds to 14m thick; Pa, Pl, Ch, Th(?), As(?), Te(?). | SUSPENSION SEDIMENTATION<br>Minor traction currents, turbidites/tempestites. | OFFSHORE -<br>Proximal Shelf |
| B1 | INTERBEDDED SILT/SAND<br><30% sand | Plane parallel and ripple lamina; occasionally massive or bioturbate; rare HCS(?); Cy, He(?). | MIXED SUSPENSION/TRACTION<br>Sediment gravity flows and rare storm beds. | OFFSHORE |
| B2 | INTERBEDDED SAND/SILT<br>30% to 70% sand | Plane parallel and ripple lamina; occassional to common HCS; locally massive; fugichnia, Cy, Ro. | MIXED TRACTION/SUSPENSION<br>Storm beds. | OFFSHORE TRANSITION |
| C1 | SILTY VERY FINE SAND<br>up to 30% silt | Internally massive to moderate angle cross beds at 15-20°; bed sets to $3m^{+}$; locally bioturbate. | TRACTION CURRENTS<br>Aqueous gravity currents. | SHOREFACE -<br>Lower to Middle |
| C2 | FINE to MEDIUM SAND<br><10% silt | Internally massive; rare moderate angle cross beds, planar and (occasional) troughs; locally bioturbate. | TRACTION CURRENTS<br>Aqueous gravity currents. | SHOREFACE -<br>Middle to Upper |
| D1 | CONGLOMERATE<br>pebble/cobble,<br>with sand,silt,shells. | Beds <20cm thick, clasts to 10cm in diameter; no evident grading; abrupt contacts; rare shell fragments. | WAVE RAVINEMENT SURFACE<br>Erosional lag. | TRANSGRESSIVE SURFACE OF EROSION |
| D2 | BIOCLASTIC CONGLOMERATE<br>with sand, silt, and rare granules | Coarse bioclastic conglomerate and coquina; beds typically 20cm to 1.5m thick; rare X-beds at 10-15°; internal scour surfaces; abrupt to erosive contacts. | TRACTION CURRENTS<br>Aqueous gravity currents,<br>Erosional lag. | UPPER SHOREFACE<br>Tidal Inlets(?), TSE Equivalent. |
| E | DISTURBED BEDS | Not a true lithofacies: includes oversteepened bedding and slumps; highly variable to discontinuous. | SOFT-SEDIMENT DEFORMATION | Not Restricted by Environment. |

COMMENTS:

1. As - *Asterosoma*, Cy - *Cylindrichnus*, Pa - *Paleophycus*, Th - *Thalassinoides*, Ro - *Rosellia*, Pl - *Planolites*, He - *Helminthopsis*, Te - *Terebellina*, Ch - *Chondrites*.
2. Shelf refers to deposition below maximum storm wave base; distal and proximal are relative terms.

### *Sedimentary Facies*

#### Facies A

Facies A consists of finely laminated silty shale (A1) to muddy siltstone (A2), with less than 10% very fine grained sand present as rare ripple laminae or discontinuous sand lamina. Differentiation of the two subfacies is primarily based on dominant grain size (mud vs. silt); the two facies are gradational and generally interbedded. Facies A2 also contains rare convolute bedding and a crude upwards coarsening not present in facies A1.

Burrowing is minimal in Facies A, and consists of an impoverished, distal *Cruziana* ichnofacies association comprised of *Planolites* and *Paleophycus*, with minor *Chondrites* and *Helminthopsis* being gradually replaced by minor to rare *Thalassinoides*, *Asterosoma* and *Terebellina*(?) from Facies A1 to A2. Depositional processes are dominated by suspension sedimentation directly from the water column, with minimal input from periodic tempestites or turbidity currents. Environments of deposition are proximal to distal shelf, with all deposition occuring below storm wave base.

#### Facies B

Facies B consists of plane parallel to ripple laminated interbedded sandstone and siltstone, with minor subordinate shale. Two subfacies are recognized based on sand:silt ratios, and represent fluctuations between suspension-dominant and traction-dominant depositional regimes. Facies B1 contains less than 30% sandstone, typically as thin rippled beds, and occasionally as massive or bioturbate horizons. Sets of low-angle, intersecting, subplanar laminae likely represent poorly developed hummocky cross-stratification deposited at lowest storm wave base. The rarity of these latter structures suggests that only the greatest magnitude storms affected the substrate to these depths.

Facies B2 is gradational with Facies B1, and contains between 30 and 70% sandstone. Sedimentary structures include plane parallel and ripple laminations, occasional massive or bioturbate beds, and occasional to common hummocky cross-stratification (Figure 6-3).

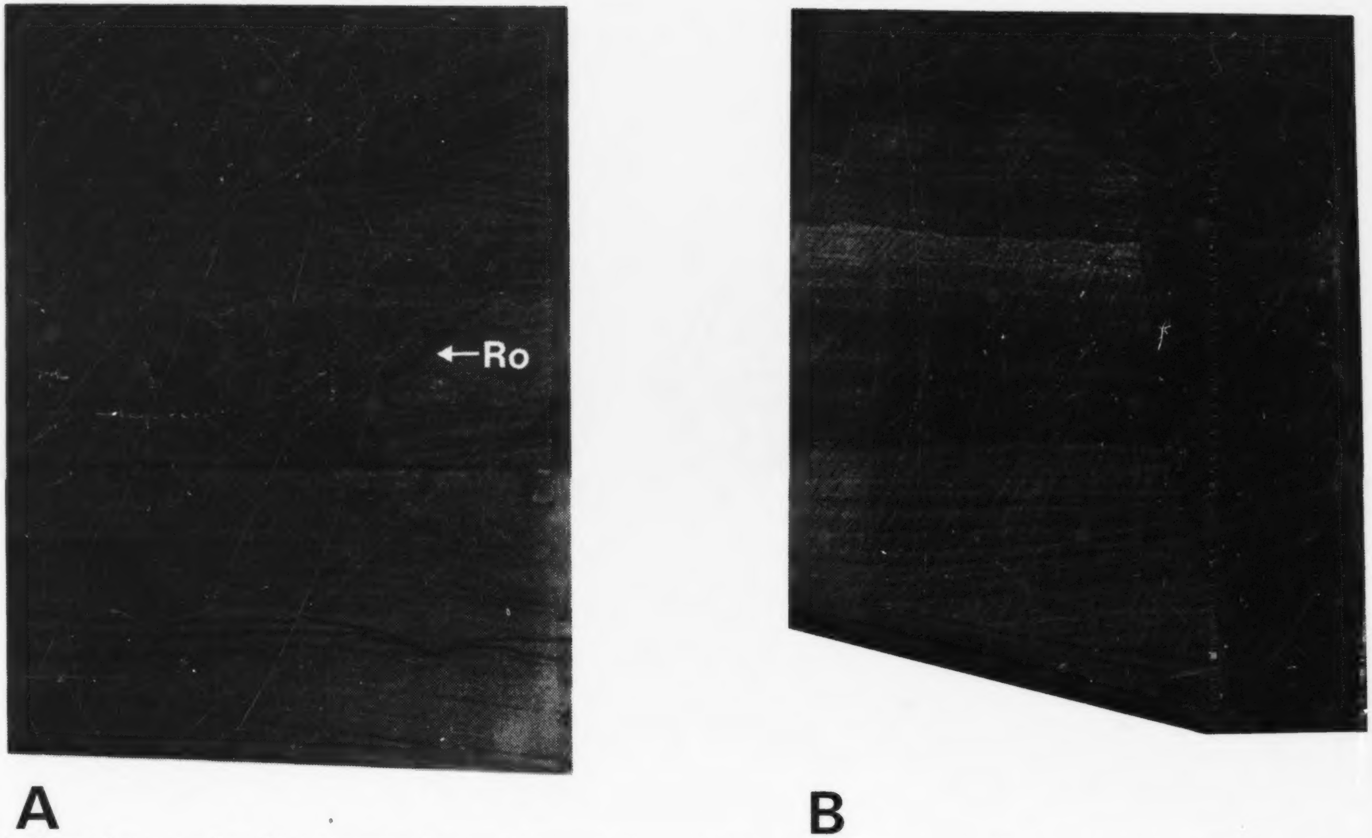


Figure 6-3. Core photographs of amalgamated storm beds and interpreted hummocky cross-stratified sand bed in facies B2.
A). 10-19-87-19/w6 at 1525.1 m with well defined *Rosellia* trace
B). d-B96-I/94-A-11 at 1388.90 m.

Individual storm beds are generally a few centimetres in thickness, but may locally be amalgamated into thicker units.

Burrowing is generally of weak to locally moderate intensity and consists of a two-phase assemblage. *Planolites, Paleophycus* and rare *Rosselia* are present in the siltier intervals, while *Paleophycus, Rosselia*, and *Cylindrichnus* appear in the sandier intervals. Rare *Skolithos* and escape structures are limited to very fine grained sand storm beds greater than 5 cm in thickness. The general increase in vertical elements, and the change from deposit feeding to mixed deposit feeding/suspension feeding strategies, results in a hybrid of the *Cruziana* and *Skolithos* ichnofacies which has been noted elsewhere in association with storm-dominated shelfal environments (*eg.* Pemberton and Frey, 1984; Vossler and Pemberton, 1989).

### Facies C

Facies C represents the primary reservoir facies in the Buick Creek area, and varies from silty, very fine sandstone with less than 30% siltstone (Facies C1), to fine to medium sandstone with less than 10% silt (Facies C2). Both subfacies are typically massive and structureless with occasional moderate angle planar-tabular cross beds at 15° to 20°. Rare trough cross-bedding in sets less than 25 cm thick is present in Facies C2. While the massive appearance can locally be attributed to bioturbation, and less commonly to fluidization, it is often obscured by calcite cementation and/or bitumen saturation. In heterolithic intervals within Facies C, the development of a robust *Thalassinoides* network is evident (Figure 6-4a) and is highlighted by the grain size variation. Cementation patterns in the massive intervals suggests that this lack of internal structure may be, in part, a function of pervasive biogenic reworking (Figure 6-4b).

Facies C bedsets may be up to 3 m thick, and are separated by internal scour surfaces and/or thin rip-up lag concentrations. Significant accumulations of Facies C1 and C2 typically overlie Facies A and B across abrupt to erosive contacts (Figure 6-5), although locally this

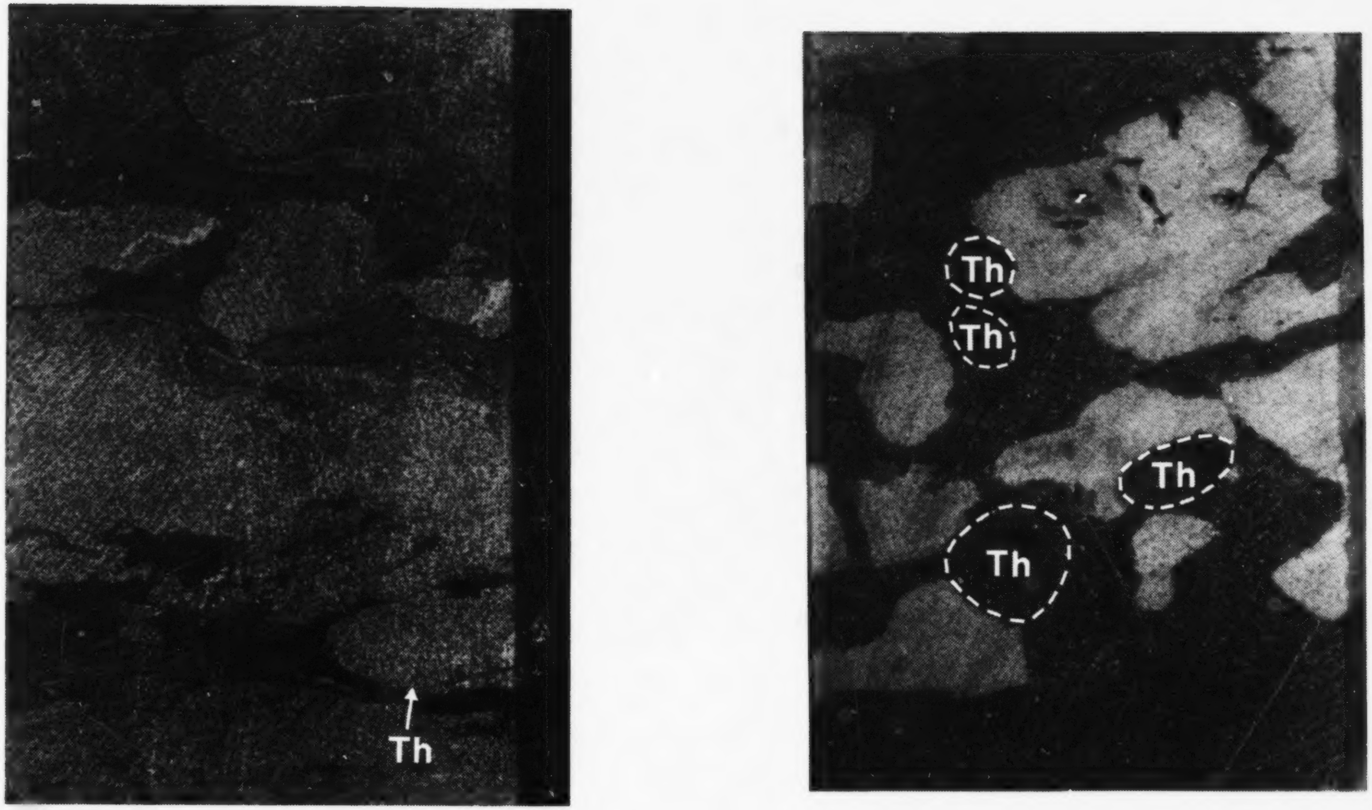


Figure 6-4. *Thalassinoides* burrows in Facies C sands.

A). *Thalassinoides* burrows in Facies C. (d-B96-I/94-A-11 at 1416.40 m)

B). *Thalassinoides* burrows marked by differential cementation. Light grey areas are calcite cemented, dark grey areas exhibit less prevasive dolomite cement and weak bitumen staining within burrows. (9-34-88-20/w6 at 1424.75 m)

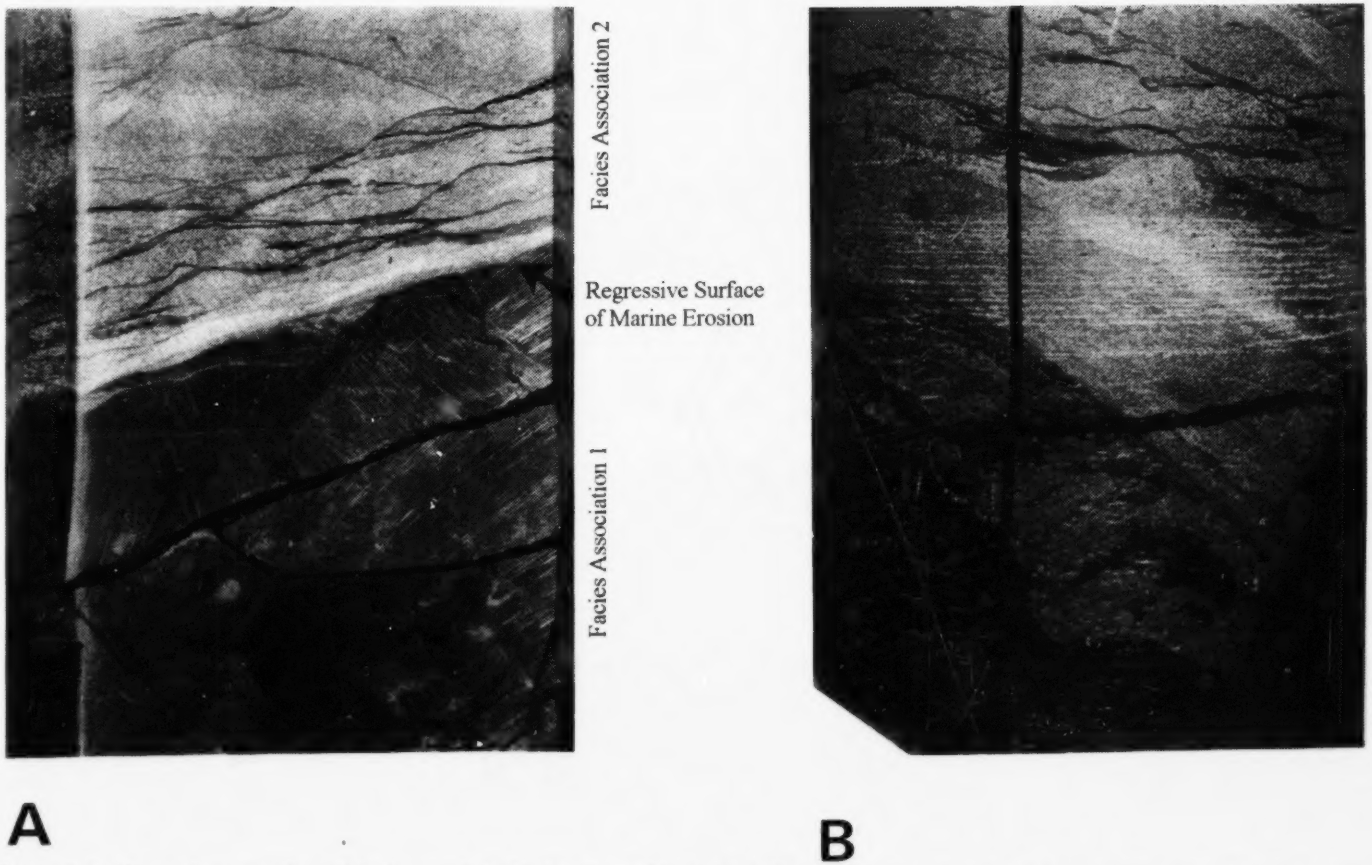

Facies Association 2
Regressive Surface of Marine Erosion
Facies Association 1
A
B

Figure 6-5. Core photographs of the base of the facies C sand in d-06-A/94-A-11. The contact is sharp, erosive and weakly pyritized.
A). Slabbed surface.
B). Whole core.

contact is partially obscured by robust *Thalassinoides* burrows and may be gradational. Deposition is from traction currents in an environment marked by significantly greater current velocities than those encountered in the offshore/offshore-transition (Facies B). In the absence of preserved, distinctive internal sedimentary structure, Facies C has been tentatively assigned to a middle shoreface (C1) to upper shoreface (C2) depositional environment.

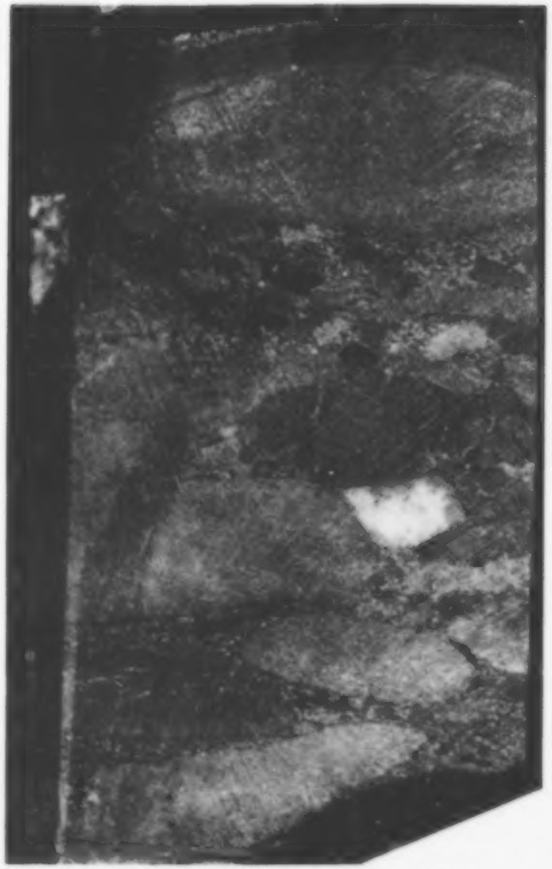
### Facies D

Facies D consists of the coarsest grained sediments present in the study area. Facies D1 is a clast-supported conglomerate containing a cobble-pebble framework with a matrix of sand, silt and rare shelly debris (Figure 6-6). Beds are less than 25 cm thick, and show no evident grading. Maximum clast size is greater than the core width (~10 cm). Facies D1 exhibits erosive bases overlying Facies C, and is abruptly overlain by deeper water sediments of Facies A and B.

Facies D2 is a bioclastic conglomerate or coquina consisting of coarse shelly debris with sand, silt and rare granules. Shell fragments range from a few mm to greater than 2 cm in length. The shelly material consists primarily of a bivalve and brachiopod hash which has been pervasively silicified and recrystallized, or is present solely as residual vugs (Figure 6-7). Beds vary from 20 cm to 1.5 m thick, with abrupt, stylolitic or erosive basal contacts, and sharp upper contacts. The thicker beds may exhibit rare cross beds at 10° to 15° and internal scour surfaces. Locally, the uppermost portion of individual beds may be marked by a predominance of granule sized rip-up clasts.

Facies D1 represents a Transgressive Surface of Erosion overlying the main reservoir facies. Facies D2 also represents erosive lag deposits; based on stratigraphic position, this facies can be equivalent to Facies D1 (TSE), or may reflect minor scours within the upper shoreface.

The Facies D2 assemblage in well 9-34-88-20/w6 is unique in both bed thicknesses



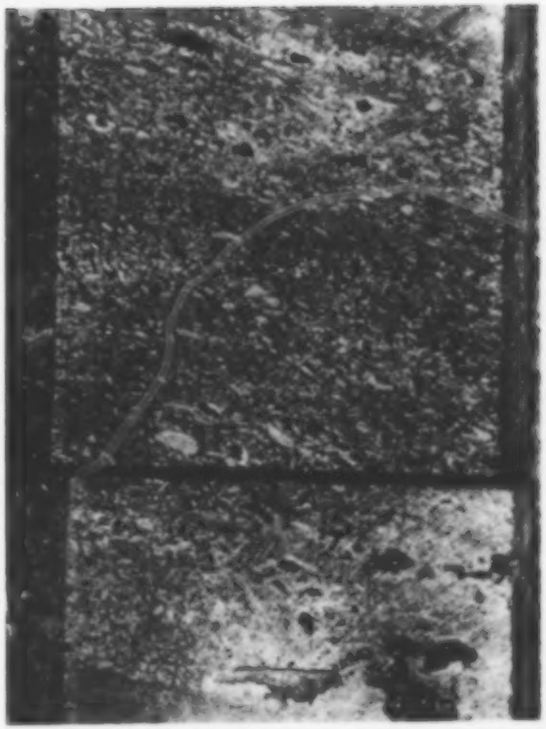


Figure 6-6. Core photographs of facies D1 transgressive lag. No grading is evident, and individual clasts are well rounded. d-76-I/94-A-11 at 1367.5 m

Figure 6-7. Core photograph of facies D2 bioclastic conglomerate. The upper contact is abrupt, but obscured by pervasive dolomitization. Note the crudely developed, low angle cross bedding marked by imbrication of the bioclasts. d-76-I/94-A-11 at 1397 m

(up to 3 m) and aggregate thickness (12 m). The bioclastic conglomerate consists of a sandy, dolomitic coquina interbedded with Facies C sandstones. The coquinas exhibit erosive bases and abrupt, planar tops (Figure 6-8). Overall bedset geometry is progradational, with bed thicknesses increasing upsection; individual beds rarely exhibit a weak fining-up marked by fine sand intercalations. The coquinas are predominantly massive; however, the development (or preservation) of moderate angle planar tabular cross beds, highlighted by a crude imbrication of bioclasts, increases with bed thickness. The abnormally thick Facies D2 assemblage in this well is interpreted as a probable tidal inlet channel within the middle to upper shoreface sequence. It represents the sole evidence for direct sediment supply in the Buick Creek Field area.

### Facies E

Facies E is not a true lithofacies *per se*, but encompasses all disturbed beds in the study area. This includes oversteepened bedding, and all soft-sediment deformation. Oversteepening of Facies C sands is one of the most dramatic features present in some Doig cores, and has been used previously to argue for syndepositional slope instability (Munroe and Moslow, 1991; Wittenberg, 1992). At the Buick Creek field, additional core recovered from intervals stratigraphically above and below the Facies C interval show core angle inclinations equal to those within Facies C units. No evidence for progressive steepening of bedding down core was observed. Based on field scale correlations, some of this oversteepening was determined to be post-depositional, likely as a result of later reactivation of basement structure. Consequently, this unit is not restricted to any depositional environment, as has been implied elsewhere in the Doig (Wittenberg, 1992).

## *Facies Associations and Stratigraphic Relationships*

### Association 1 - Offshore/Shelf

The lower Doig interval, underlying the Doig sandstones present at Buick Creek, is composed of an assemblage of Facies A and B1 with a minor component of Facies B2. This assemblage is representative of deposition under quiet water conditions in an offshore/shelf

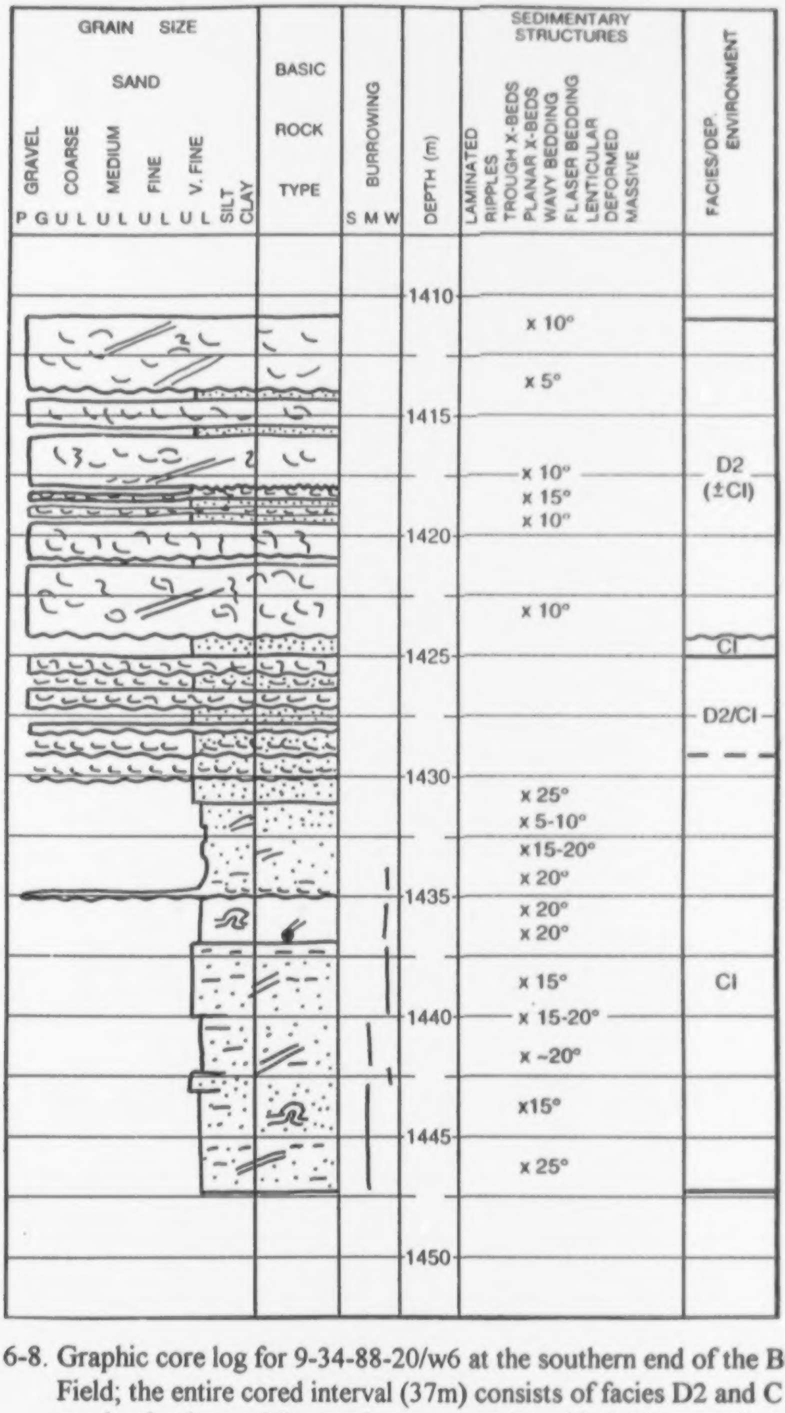

GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC
ROCK
TYPE
BURROWING
S M W
DEPTH (m)
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
FACIES/DEP. ENVIRONMENT
1410
1415
1420
1425
1430
1435
1440
1445
1450
x 10°
x 5°
x 10°
x 15°
x 10°
x 10°
x 25°
x 5-10°
x15-20°
x 20°
x 20°
x 20°
x 15°
x 15-20°
x ~20°
x15°
x 25°
D2
(±CI)
CI
D2/CI
CI

Figure 6-8. Graphic core log for 9-34-88-20/w6 at the southern end of the Buick Creek Field; the entire cored interval (37m) consists of facies D2 and C1. The productive interval lies on the same stratigraphic horizon as the rest of the Doig sands andis interpretted as a tidal inlet.

setting dominated by suspension settling. Suspension sedimentation is punctuated by infrequent storm-related traction currents (shale, siltstone and rare silty, very fine sand lamina). The overall pattern in this association is a crude coarsening upwards trend, from predominantly shale to predominantly siltstone, and reflects a gross progradational system.

The basal component of the offshore/shelf association includes a thick, highly radioactive shale interval marked by high phosphate and organic contents, and informally refered to as the "Phosphate Zone" (Edwards *et al*, 1994). The Phosphate Zone represents a classic condensed section deposited as the final phase of a transgressive systems tract. The top of the main Phosphate Zone (not cored) thus represents a maximum flooding surface, and the initiation of a highstand systems tract. The remainder of this association represents the early highstand systems tract, and includes all cores stratigraphically below the main Doig sandstone at Buick Creek.

### Association 2 - Shoreface

The siltstones and shales of the offshore/shelf facies association are abruptly overlain by sandstones of the shoreface facies associations, which are informally referred to as the Doig Sand. The basal surface is sharp to erosive (Figure 6-5), and progressively truncates strata down section in a basinal direction (Figure 6-9a). This surface is frequently mineralized, weakly scoured, and may be marked by a thin shale rip-up lag. The incorporation of significant shale clasts along this horizon locally produces what appears as a gradational, coarsening-up signature on gamma ray logs (eg. b-77-I, Figure 6-9b). Similar deflections of gamma ray log signatures by included erosional debris have been documented elsewhere in the literature (Selly, 1979).

The main Doig Sand consists of Facies C1, C2 and locally D2, interbedded with subordinate Facies B2 (siltstones and dirty sandstones). Deposition represents traction sedimentation in lower shoreface through upper shoreface settings, and this association is the sole reservoir target in the Buick Creek field. The shoreface association may be up to 30 m

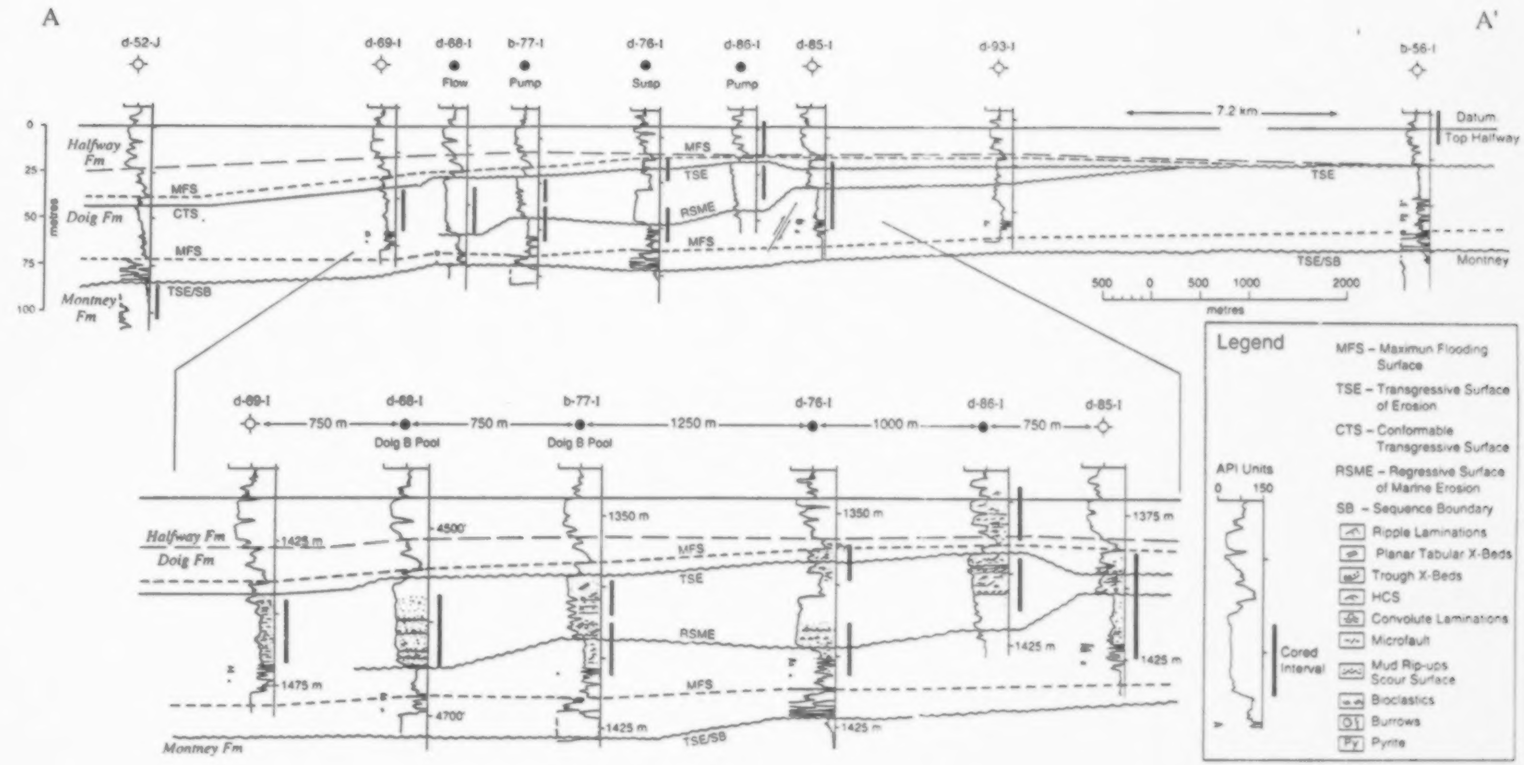

A
A'
d-52-J
d-69-I
d-68-I
b-77-I
d-76-I
d-86-I
d-85-I
d-93-I
b-56-I
Flow
Pump
Susp
Pump
7.2 km
Datum
Top Halfway
metres
0
25
50
75
100
Halfway Fm
Doig Fm
Montney Fm
MFS
CTS
MFS
TSE/SB
MFS
TSE
RSME
MFS
TSE
TSE/SB
Montney
500
0
500
1000
2000
metres
750 m
750 m
1250 m
1000 m
750 m
Doig B Pool
Doig B Pool
1425 m
1475 m
4500'
4700'
1350 m
1425 m
1350 m
1425 m
1425 m
1375 m
1425 m
Halfway Fm
Doig Fm
MFS
TSE
RSME
MFS
TSE/SB
Montney Fm
Legend
API Units
0
150
Cored Interval
MFS – Maximun Flooding Surface
TSE – Transgressive Surface of Erosion
CTS – Conformable Transgressive Surface
RSME – Regressive Surface of Marine Erosion
SB – Sequence Boundary
Ripple Laminations
Planar Tabular X-Beds
Trough X-Beds
HCS
Convolute Laminations
Microfault
Mud Rip-ups Scour Surface
Bioclastics
Burrows
Py Pyrite

Figure 6-9. Dip-oriented stratigraphic cross-section A-A' through the centre of the Buick Creek Field.

A). Regional section with gamma-ray log profile and core control for each well. The base of the Doig sand represents a marine erosion surface (RSME) which is truncated landward by the overlying transgressive surface, progressively truncating strata down-dip in a basinward direction.

B). Field scale gamma-ray and core section showing relationships between facies associations and gross stratigraphic framework in selected wells from 6-9a. Facies association 2 sands abruptly to erosively overlie offshore silts and muds of association 1. The Doig sand is marked by rapid down-dip facies changes from oversteepened to massive sands to silt with rare rippled to convolute sand lamina over a distance of ~750m.

thick, thins rapidly both up and down dip (Figure 6-9) and is capped by Facies D conglomerates (Figure 6-6: Transgressive Surface of Erosion).

The basal contact of the shoreface association represents a regressive surface of marine erosion. This surface is truncated landward by the overlying transgressive surface, and the two merge basinward to become a correlative conformity (Figure 6-9a). The resultant sand body represents a major basinward shift in facies. The transgressive lag is capped by a pronounced flooding surface that can be correlated beyond the limits of the study area.

### Association 3 - Offshore Transition

Facies Association 3 includes the upper Doig and lower Halfway lithostratigraphic units, and represents the basal portion of a larger progradational cycle that coarsens up into shoreface sandstones attributed to the Halfway formation. This basal portion consists primarily of Facies A2, B1 and B2, grading and coarsening up into Facies B2 and C. Spatially, Facies A2 and B1 become more significant to the southwest and south (basinward), with Facies B2 predominant to the north and northeast (Figures 6-9a, 6-10a); the storm-dominated offshore transition thus grades basinward into offshore and shelfal sediments deposited below the influence of storms. This association is similar to the offshore/shelf association (Association 1), but can be differentiated based on stratigraphic position, increased sand content, and prevalance of hummocky cross-stratification.

## Discussion

### *Sand Body Geometry and Implications for Sequence Stratigraphy*

Although the Doig Sand reservoir at Buick Creek has been subdivided into a number of different productive pools, along-strike correlations clearly demonstrate that these represent a single stratigraphic horizon with no evidence for significant facies changes between pools (Figure 6-10). Net sand distribution within Facies Association 2 clearly defines a pronounced linear pattern (Figure 6-11), oriented subparallel to the inferred paleoshoreline and normal to depositional dip. Sand thickness is irregular along strike, varying from less than

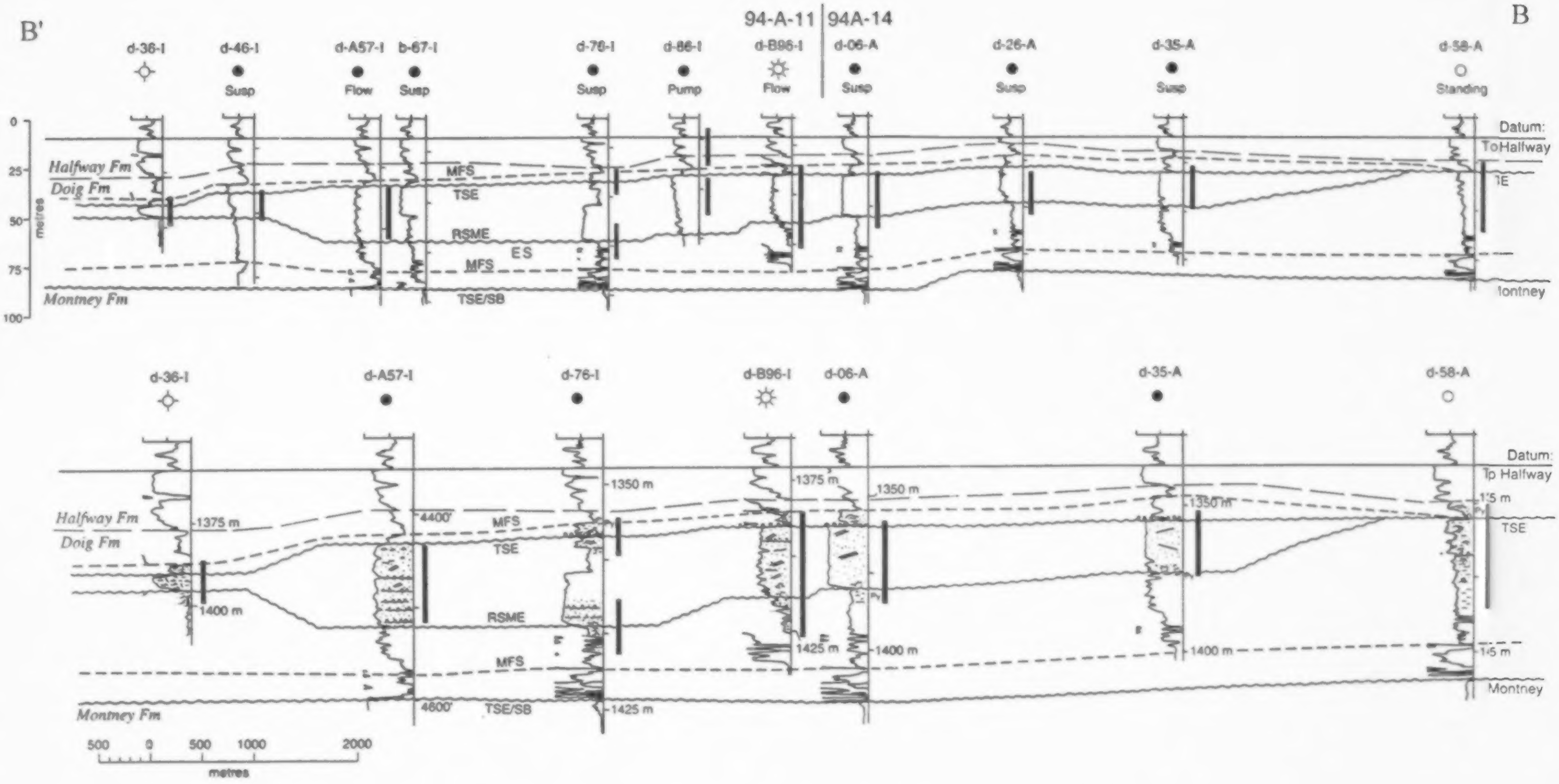

B'
B
94-A-11
94A-14
d-36-I
d-46-I
Susp
d-A57-I
Flow
b-67-I
Susp
d-76-I
Susp
d-86-I
Pump
d-B96-I
Flow
d-06-A
Susp
d-26-A
Susp
d-35-A
Susp
d-58-A
Standing
0
25
50
75
100
metres
Datum:
To Halfway
Halfway Fm
Doig Fm
MFS
TSE
RSME
ES
MFS
TSE/SB
Montney Fm
Montney
1350 m
1375 m
1400 m
1425 m
4400'
4600'
15 m
Datum:
Tp Halfway
500
0
500
1000
2000
metres

Figure 6-10. Strike-oriented stratigraphic cross-section B-B' through the axis of the Buick Creek Field.

A). Regional section with gamma-ray log profile and core control for each well. The dramatic decrease in sand thickness in the vicinity of well d-36-I/94-A-11 is partially a reflection of a dip-oriented element in the section.

B). Field scale gamma-ray and core section showing relationships between facies associations and stratigraphic framework in selected wells from 6-10a. Facies association 2 is capped by a coarse transgressive lag to the north and an equivalent bioclastic lag to the south. Where the basal contact is not obviously erosive in core it is heavily pyritized. See Figure 6-9 for legend.

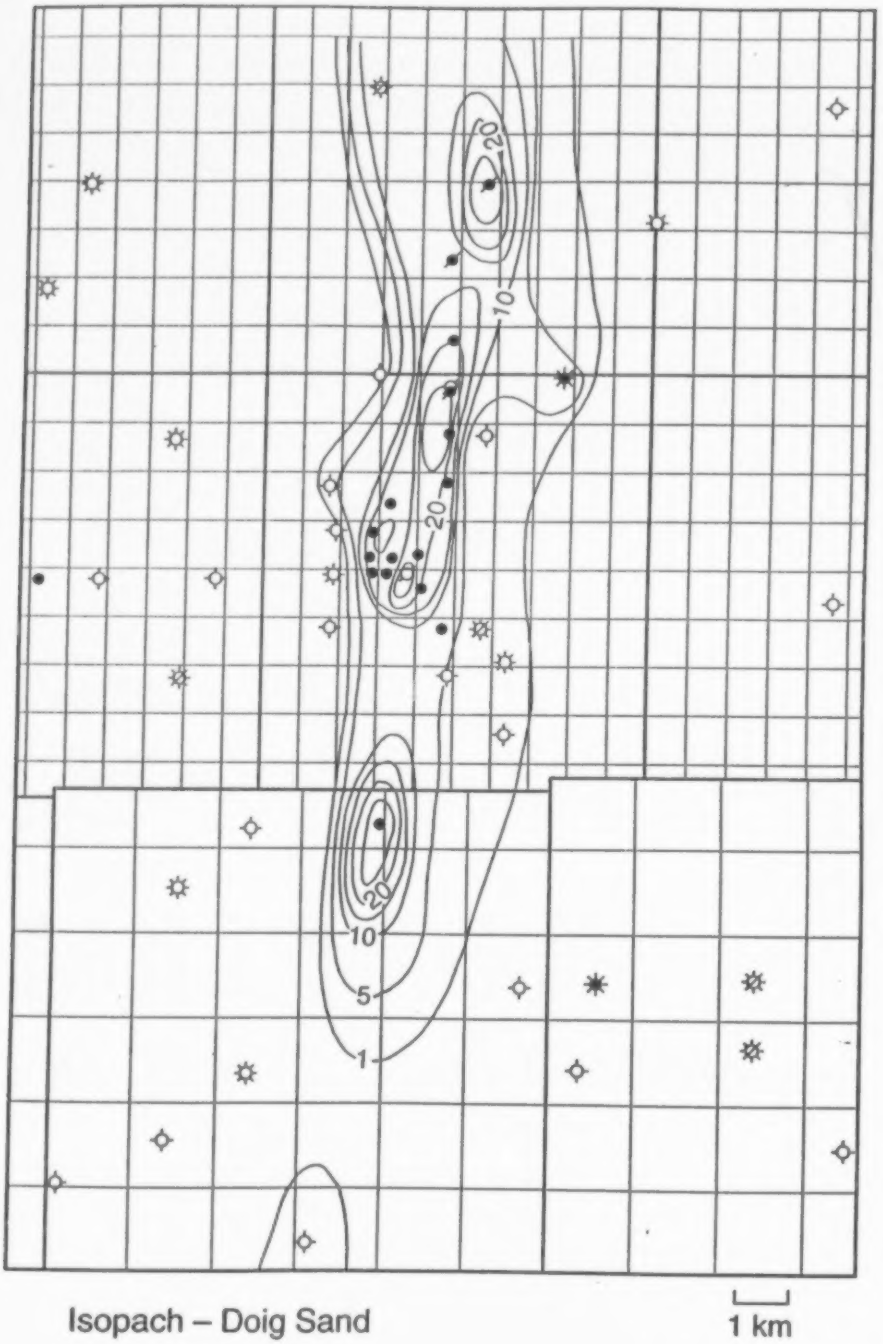

20
10
20
20
10
5
1
Isopach – Doig Sand
1 km

Figure 6-11. Net sand isopach for the Doig sand (facies association 2) at Buick Creek . Where no core is available, gamma-ray log sand cut-off equals 60° API based on log-core correlation in adjacent wells.

5 m to greater than 25 m. Strike length of the main sandstone body (greater than 5 m contour) exceeds 19 km, and is open to the north. Dip dimensions are variable, but average less than 2 km for a strike to dip ratio of approximately 10:1.

The thickest sandstones appear to be symmetrically distributed about the sand body axis, but a weak asymmetry is evident in the less than 5 m thick interval (Figure 6-11), with the sands spread out in a landward direction rather than basinward. This asymmetry is more pronounced in dip-oriented sections than in plan view, and is interpreted to represent reworking and backstripping of shoreface sands during a subsequent transgressive erosional event. This geometry can be generated by either shoreface erosion, or infilling of a pre-existing half-graben. Although the number of deep well penetrations are inadequate to constrain a structural control, the sharp, erosive nature of the basal surface argues against sedimentation into an existing structure.

Facies changes are abrupt, both vertically and laterally. The shoreface sandstones (Facies Association 2) abruptly overlie offshore siltstone and shales of Facies Association 1 across an erosive contact. This represents a significant basinward shift in facies, and development of a lowstand shoreface. As there is no evidence of subaerial exposure at this surface, either locally or regionally, it does not represent a sequence boundary *sensu stricto* (Van Wagoner *et al.*, 1988; 1990). This surface is interpreted as a subaqueous ravinement surface (regressive surface of marine erosion) reflecting either a higher order sea level fluctuation (high frequency sequence boundary) or a tectonically induced fall in relative sea level. This is essentially the same as similar sharp-based, shoreface sandstones found elsewhere, which have been [illegible] "forced regression" shorefaces (Plint, 1991; Posamentier *et al.*, 1992).

A eustatically driven fall in sea level has not been documented in the Middle Triassic of the Western Canada Sedimentary Basin. However, a Late Anisian relative sea level fall has been postulated in the Sverdrup Basin of the Canadian Arctic (Embry, 1988), and is shown on the global eustatic sea level charts of Haq

interpreted to represent an element of the lowstand systems tract.

The shoreface sandstones are erosionally overlain by a coarse lag deposit, followed by much finer-grained offshore to offshore transition sediments. The lag represents a transgressive surface of erosion which amalgamates with the regressive surface of marine erosion in a landward direction (Figure 6-9). The transgressive lag is overlain by a marine flooding surface and a single retrogradational parasequence which onlaps the amalgamated TSE/RSME landward. This backstepping parasequence represents the total thickness of the transgressive systems tract in the study area. The subsequent highstand systems tract reflects a renewal of the progradational architecture typical of the Halfway-Doig interval in northeastern B.C.

### *Exploration Significance*

The geometry and stratigraphic setting of the Doig Sands at Buick Creek can be used to develop a predictive model for use in both the exploration for, and the development of, similar sandstones occuring elsewhere in the Doig Formation. The Doig Sands are narrow, linear sandstone bodies oriented with their depositional axes elongate parallel to the inferred paleoshoreline.

The interpretation of these sandstones as forced lowstand shoreface deposits makes this a necessary and predictive geometry. In the absence of significant structural relief, following a drop in sea level across a low-gradient exposed shelf, the new shoreline will develop parallel to the paleocoastline. If the subsequent transgression follows abruptly, there is little opportunity to establish a full shoreface profile. In the absence of a major fluvial discharge site, only a thin, immature shoreline will develop. Alternatively, a more mature shoreface may develop and be stripped during the subsequent transgression (Plint, 1988; Walker and Plint, 1992).

emphasize strike continuity. Dip dimensions are extremely limited; however, several possible proximity indicators can be defined. Down dip facies changes are abrupt, from shoreface sandstones to offshore transition siltstones with minor rippled sandstone and rare hummocky cross stratification. Storm-wave loading of the shoreface during the subsequent transgression may produce local liquifaction of the sand bodies, as evidenced by local oversteepening and massive sandstones, and can be predicted to result in shoreface failure. The resultant mass transport may explain thin, slightly coarser-grained intervals (stray sands) deposited downdip along the regressive surface of marine erosion (Figure 6-9b: d-52-J/94-A-11). In plan view these sandy siltstones should exhibit a lobate geometry normal to the paleoshoreline.

The weak updip assymetry to the sandstone, and the bioclastic lag which caps Facies Association 2, are both a result of shoreface reworking and backstripping during the ensuing transgression. Thin intervals of Facies D2 equivalent bioclastic sandstones should be present updip from the Doig Sands as a transgressive lag deposit. The implication of Figure 6-9b is that these lags decrease in thickness abruptly up dip away from the shoreface (d-86-I/94-A-11 to d-85-I/94-A-11), and within a few kilometres may be represented by as little as a few shells. As the lowstand and transgressive surfaces merge along strike, or updip, a compressed Facies Association 2 is preserved consisting of 2 to 4 m of Facies D2 bioclastic conglomerate (Figure 6-10b: d-36-I/94-A-11, this same bioclastic unit is present in d-44-I and d-45-I).

The trend of the paleoshoreline during the time of deposition of the Halfway-Doig interval is oriented slightly oblique to the present structural gradient. This, when combined with differential compaction over the Doig Sands, can result in the development of a subtle deflection in structural contours drawn on the top of the overlying Halfway Formation (Figure 6-12). The subtlety of this anomaly is due to the small angle of intersection between the two orientations; however, in areas of sufficient well control, fine-scale contouring produces a definite south-trending arch over the Doig Sands. The detail and control required for the resolution of these sandstones likely precludes the utility of this approach on a regional basis;

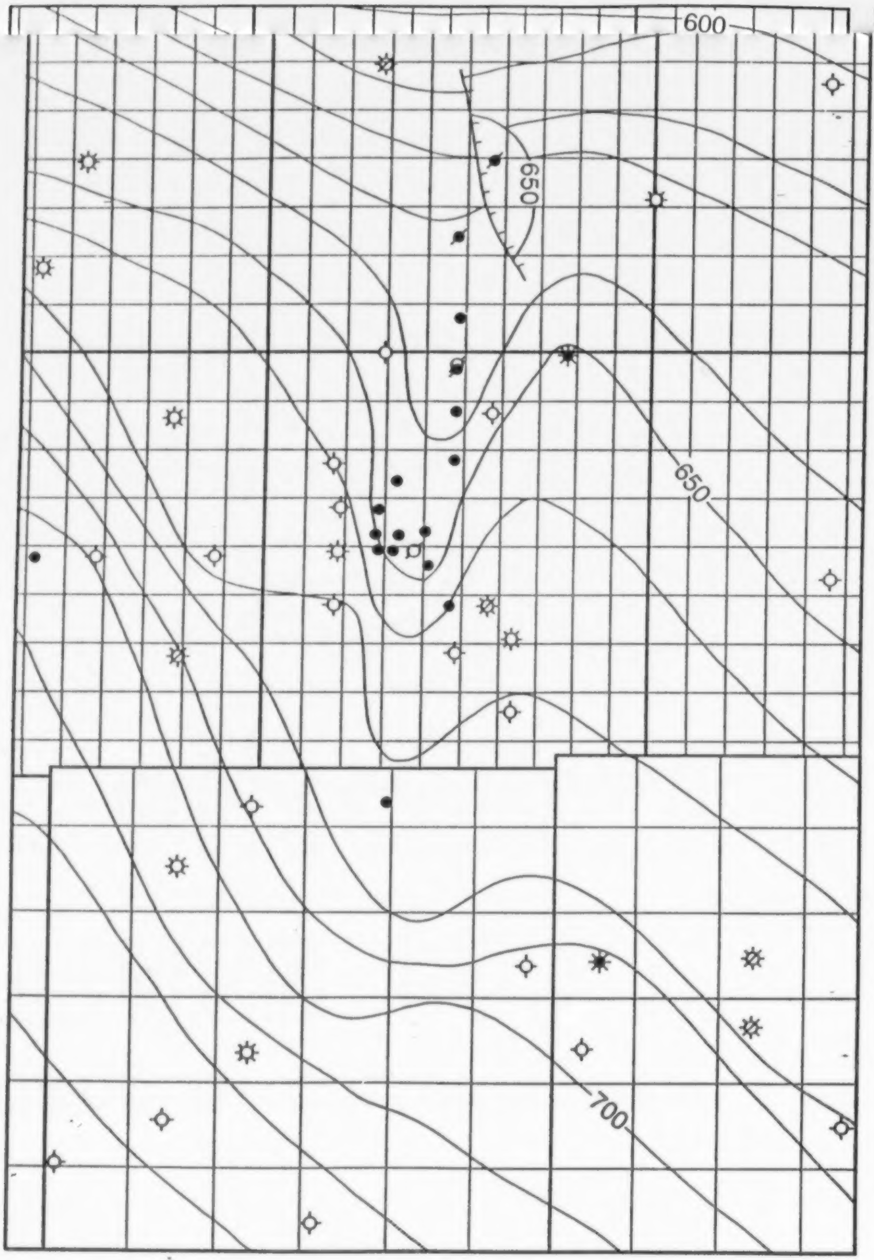

600
650
650
700
Halfway Structure
C.I. = 10 m
1 km

Figure 6-12. Structure map drawn on the top of the Halfway Formation. The pronounced southerly deflection in contours over Buick Creek represents differential compaction over the Doig sands. In other areas where well density of Halfway penetrations is high enough, such subtle structural anomalies may provide a significant exploration tool

its value lies in re-examining areas of historic Halfway or basal Charlie Lake production where there is a large database of available Halfway penetrations, but relatively few Doig penetrations.

## Conclusions

Sedimentary facies identified from the Doig Formation in the Buick Creek Field area can be grouped into three Facies Associations: (1) offshore/shelf, (2) shoreface, and (3) offshore transition. All production is from Facies Association 2 which consists of fine-grained, massive to structureless sandstone. Facies Association 2 erosively overlies Facies Association 1, and is abruptly overlain by Facies Association 3 across a pronounced transgressive surface of erosion. The thickest sandstones are symmetrically distributed about the sand body axis, with a weak asymmetry in the < 5 m thick interval. This asymmetry is interpreted to represent reworking and backstripping of shoreface sands during a subsequent transgressive erosional event.

The Buick Creek field represents a lowstand shoreface deposited during a Late Anisian fall in relative sea level. Although it cannot be resolved whether this sea level fall is eustatically or tectonically controlled, this characterization allows construction of a depositional model which can be used as a guide for future hydrocarbon exploration. The orientation of these sandstones implies that exploration should emphasize strike continuity.

Net sandstone distribution defines a pronounced linear pattern oriented subparallel to the paleoshoreline, exceeding 19 km in length, and open to the north. Dip dimensions are limited, but several proximity indicators can be defined including (1) abrupt down dip facies changes from shoreface sandstones to offshore siltstones and shales, (2) local storm-wave induced loading of the shoreface during transgression producing local liquifaction, oversteepening and massive sands, (3) stray sandstones downdip along the regressive surface of marine erosion, and (4) thin Facies D2 bioclastic lags immediately updip from the Doig Sands.

The Halfway/Doig paleoshoreline is oriented slightly oblique to the present structural gradient which, combined with differential compaction over the Doig Sands, results in a weak deflection of structural contours drawn on the top of the Halfway Formation. The subtlety of this anomaly likely precludes its use on a regional basis, but it may be of value in re-examining areas where a large database of Halfway penetrations is available, regardless of the number of Doig penetrations.

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# CHAPTER 7.

# LOWSTAND SHOREFACES IN THE DOIG FORMATION (MIDDLE TRIASSIC): HIGH FREQUENCY SEQUENCE BOUNDARIES AND IMPLICATIONS FOR HYDROCARBON EXPLORATION IN NORTHEASTERN BRITISH COLUMBIA.

## Introduction

The Lower Halfway and Doig formations in northeastern British Columbia contain a number of narrow, elongate sandstone bodies oriented subparallel to the paleoshoreline. These sandstones have been described as shelf sands, and are considered to represent the greatest potential gas resource in the Triassic of the Western Canada Sedimentary Basin (Bird *et al.*, 1994). Estimated undiscovered in place volumes exceed 100 billion $m^3$ gas (~4 TCF). In recognition of the significance of the Halfway/Doig play, and anticipated interest therein, a sequence stratigraphic reconstruction of anomalously thick Doig sandstones was undertaken to develop a predictive depositional model. Following industry usage, these sandstones are refered to informally as the Doig Sand herein.

In this study, existing Doig fields in the Fort St. John area are characterized using a process sedimentologic approach to infer depositional processes, document facies associations, and determine depositional environments present in the Doig Formation. These data allow for the development of a depositional model within a sequence stratigraphic framework, and address the implictions of tectonics and paleogeography for exploration trends. This represents the first concerted attempt to place the Doig Formation of northeastern British Columbia within a high-frequency sequence stratigraphic context, and develops a model significantly different from those of previous authors.

### *General Stratigraphy*

Middle Triassic strata of northeastern British Columbia represent a progradational sequence of shallow marine to marine clastic sediments deposited on the western flank of the

North American craton (Gibson and Barclay, 1989). Structurally, the continental shelf was underlain by a passive margin, but evidence indicates that syndepositional faulting exerted some degree of control over local sediment accumulation (eg. Cant, 1984; 1986; Caplan, 1992; Qi, 1995). This syndepositional deformation may reflect relaxation of individual structures associated with the Peace River Arch and Dawson Creek Graben Complex, or reactivation of basement faults.

In the subsurface, these strata are subdivided into two broad lithostratigraphic units, the Halfway and Doig formations (Table 7-1). The Doig Formation is composed of shale, siltstone, and minor sandstone, with a thick, highly-radioactive phosphatic shale section near the base (Armitage, 1962). The Doig is transitional upsection into shallow marine sandstones and coquinas attributed to the Halfway Formation (Hunt and Ratcliffe, 1959). The difficulty in differentiating the two is well established (eg. Edwards *et al.*, 1994).

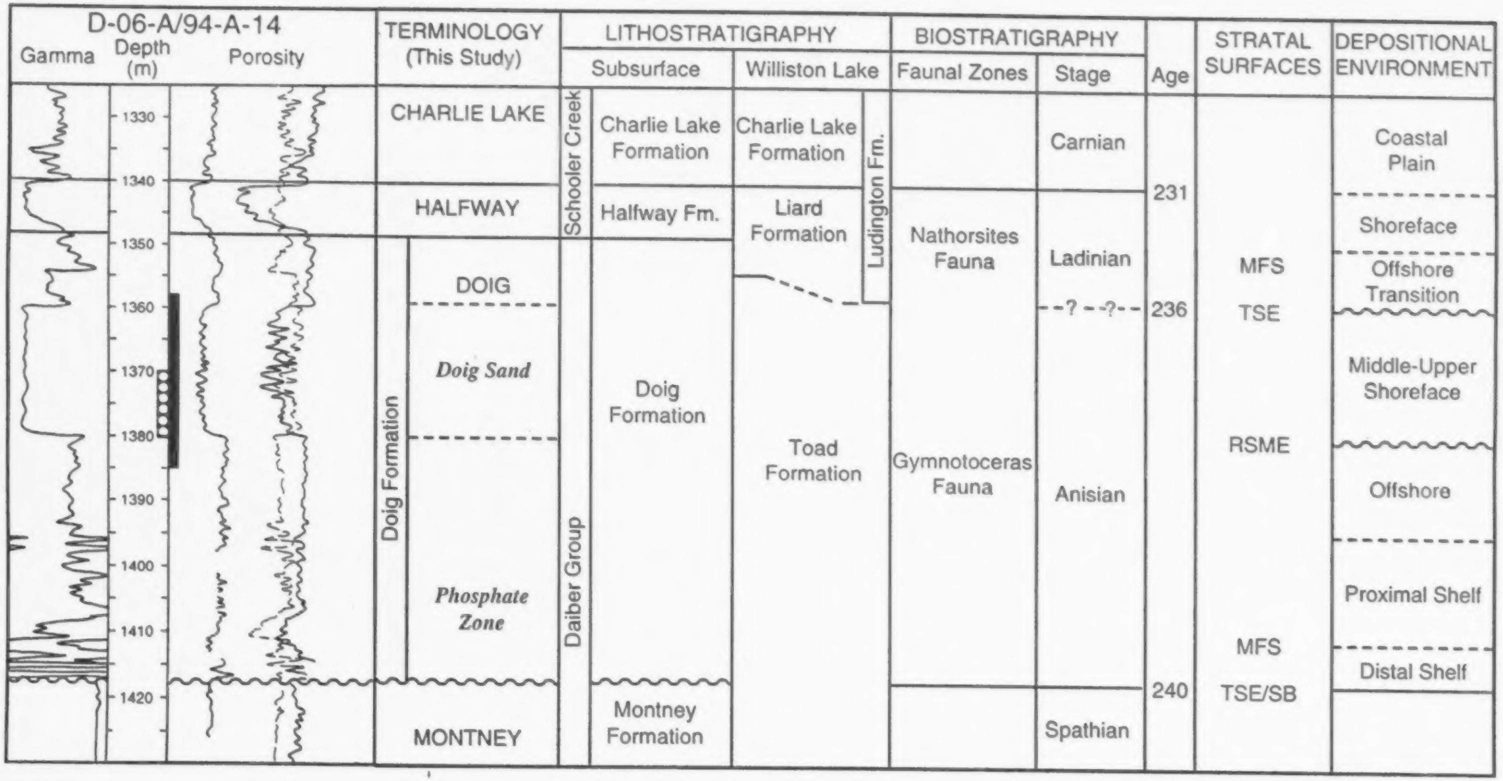
The Halfway/Doig contact has been described as a disconformity (Dawes, 1990) or, locally, as an unconformity (Chunta, 1969; Campbell and Horne, 1986). Others argue that this contact does not represent a regionally correlatable stratigraphic break (Willis, 1992; Wittenberg, 1992). The two formations are treated herein as a single, continuous unit (Table 7-1) which unconformably overlies the Montney Formation, and is abruptly overlain by marginal to non-marine clastics, evaporites and carbonates of the Charlie Lake Formation.

### *Database/Methodology*

The study area constitutes approximately 6000 km sq (75 by 80 km) in the Fort St. John area of northeastern British Columbia, and includes the Buick Creek, Cache Creek, Fireweed and Stoddart-West Doig pools (Figure 7-1). The largest of these fields is the Buick Creek field, which has been presented elsewhere (CHAPTER 6). This study represents an expansion of the earlier study.

The initial database for this study consisted of 722 wireline logs and 63 cored intervals

TABLE 7-1. Table of stratigraphic terminology for the Middle Triassic in northeastern B.C. (from Evoy and Moslow, *in press*). Lithostratigraphic terminology and stages from Gibson and Barclay (1989), faunal zones from Tozer (1961).


D-06-A/94-A-14
Gamma
Depth (m)
Porosity
1330
1340
1350
1360
1370
1380
1390
1400
1410
1420
TERMINOLOGY (This Study)
CHARLIE LAKE
HALFWAY
DOIG
Doig Sand
Phosphate Zone
Doig Formation
MONTNEY
LITHOSTRATIGRAPHY
Subsurface
Schooler Creek
Daiber Group
Charlie Lake Formation
Halfway Fm.
Doig Formation
Montney Formation
Williston Lake
Charlie Lake Formation
Liard Formation
Ludington Fm.
Toad Formation
BIOSTRATIGRAPHY
Faunal Zones
Nathorsites Fauna
Gymnotoceras Fauna
Stage
Carnian
Ladinian
--? --?--
Anisian
Spathian
Age
231
236
240
STRATAL SURFACES
MFS
TSE
RSME
MFS
TSE/SB
DEPOSITIONAL ENVIRONMENT
Coastal Plain
Shoreface
Offshore Transition
Middle-Upper Shoreface
Offshore
Proximal Shelf
Distal Shelf

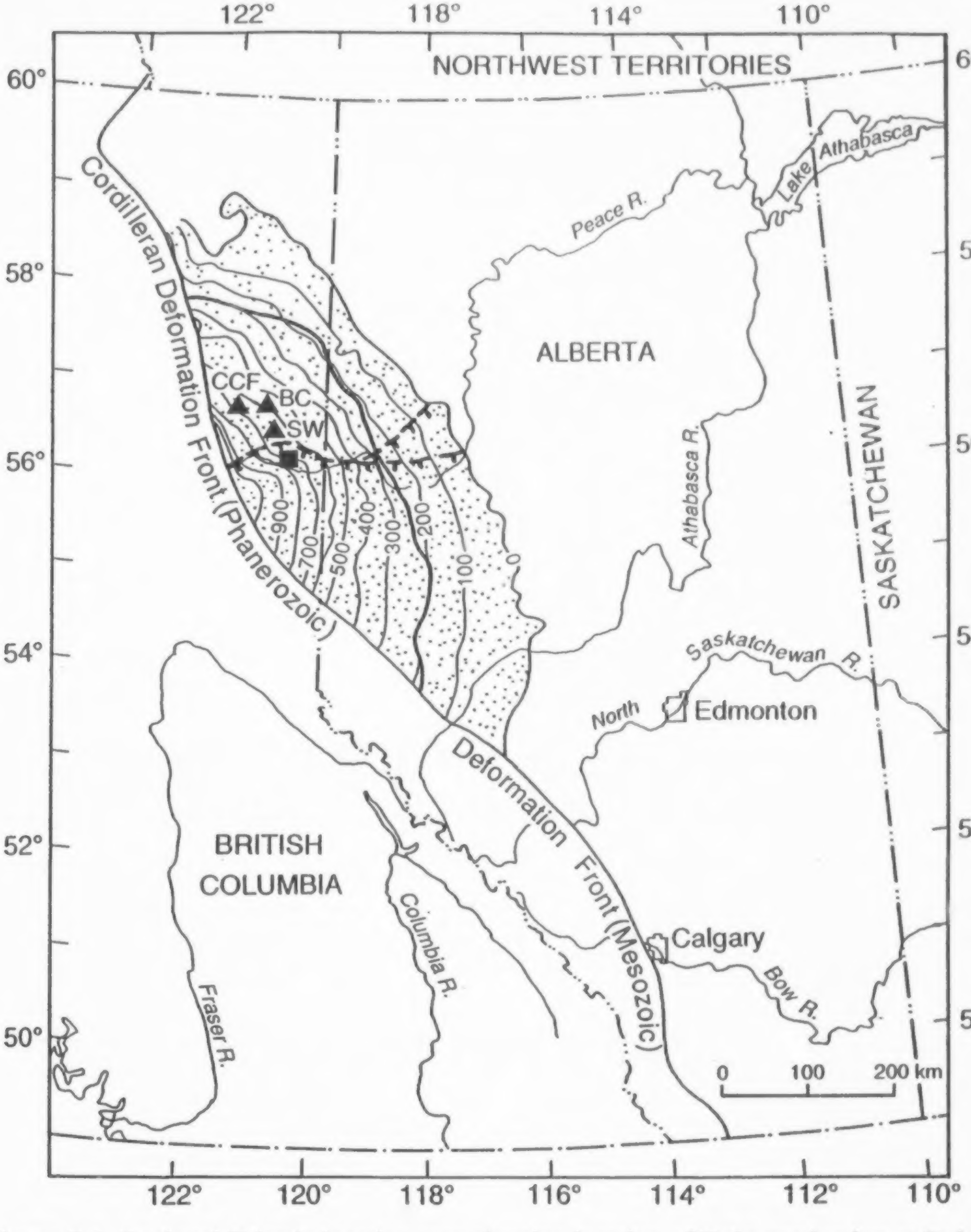

122°
118°
114°
110°
60°
NORTHWEST TERRITORIES
Lake Athabasca
Peace R.
58°
Cordilleran Deformation Front (Phanerozoic)
ALBERTA
CCF
BC
SW
56°
Athabasca R.
SASKATCHEWAN
900
700
500
400
300
200
100
0
54°
North Saskatchewan R.
Edmonton
Deformation Front (Mesozoic)
52°
BRITISH COLUMBIA
Columbia R.
Calgary
Bow R.
50°
Fraser R.
0
100
200 km
122°
120°
118°
116°
114°
112°
110°

Figure 7-1. Regional Triassic location map showing location of Doig production at Buick Creek (BC), Cache Creek/Fireweed (CCF) and Stoddart-West (SW) as solid triangles. Solid square represents Fort St. John. Contour interval for Triassic isopach equals 100 metres, solid heavy line approximating the 200 m contour represents the erosional edge of the Halfway/Doig interval. Heavy dashed lines represent the flanks of the Dawson Creek Graben Complex. Modified from Edwards *et al.* (1994) and Henderson *et al.* (1994).

from 54 wells, totalling 1152 m. Thirty nine wells (846.6 m) have cored the Halfway/Doig interval within the study area (Table 7-2). All cores were described using a process sedimentologic approach (*cf* Seimers and Tillman, 1981) stressing genetically related beds and bed set characteristics, and delineation of vertical facies associations in core. Sand cut-off for isopachs was established at 60° API based on core-gamma correlation.

Documentation of major stratigraphic discontinuities was based on both core data and recognition on wireline logs. All 722 wireline logs penetrate the Halfway (Figure 7-2), with 475 of these deep enough to test for the Doig Sand. Two stratigraphically distinct sandstones were documented. The first sandstone is present in 163 wells, and has been partially cored in 23 wells. The second sandstone stratigraphically overlies the first, is located 10 to 20 km furter basinward, and is present in 52 wells. The second Doig sandstone has only been cored in 4 wells.

All pool reserves and reservoir parameters were determined as of December 31, 1991, and are summarized from publications of the Energy Resources Division of the British Columbia Ministry of Energy Mines and Petroleum Resources (EMPR, 1991).

## Sedimentary Facies and Facies Associations

All facies herein have been defined previously, based on their observed physical characteristics (CHAPTER 6; Evoy and Moslow, 1995; Evoy and Moslow, *in press*). Four major facies were recognized based on lithology, primary physical and biogenic sedimentary structures, bedding geometry, and the nature of their bounding surfaces. Each facies was subdivided based on texture (percent sand, maximum clast size). A final facies class was assigned for all intervals with significant degrees of apparent soft-sediment deformation. A total of nine sedimentary facies were thus recognized (Table 7-3).

Commonly recurring groupings of lithofacies were classified together to define facies associations characteristic of gross depositional environments (Figure 7-3). Three facies

TABLE 7-2. Database Summary (see also: Figure 7-2)

| UWI | Formations | Length | Area |
|---|---|---|---|
| 12-24-84-21/w6 | Doig | 14.85 | Regional |
| 11-31-85-21/w6 | Doig | 17.90 | Red Creek |
| (02) 6-04-86- | Doig | 17.45 | Stoddart |
| 12-04-86-20/w6 | Doig | 17.50 | Stoddart |
| 16-15-86-20/w6 | Doig | 10.50 | Stoddart |
| 10-25-86-20/w6 | Doig | 17.30 | Stoddart |
| 10-19-87-19/w6 | ChLk-Doig | 37.80 | Regional |
| 6-22-87-20/w6 | Hfwy | 5.15 m | Stoddart |
|  | Doig | 12.40 | (A Pool) |
| (02) 6-26-87- | Hfwy | 13.30 | Regional |
| 6-21-88-19/w6 | ChLk-Hfwy | 15.00 | Regional |
| 7-24-88-20/w6 | Hfwy | 14.40 | Buick |
| 9-34-88-20/w6 | Doig | 36.40 | Buick |
| a-29-K/94-A-10 | ChLk-Hfwy | 4.80 m | Regional |
|  | Hfwy-Doig | 17.20 | Regional |
| d-87-K/94-A-10 | Halfway | 13.75 | Regional |
| d-36-I/94-A-11 | Hfwy/Doig | 12.80 | Buick |
| b-44-I/94-A-11 | Hfwy/Doig | 18.65 | Buick |
| d-45-I/94-A-11 | Doig | 17.70 | Buick |
| d-46-I/94-A-11 | Doig | 13.50 | Buick |
| (02)d-57-I/94-A- | Doig | 25.00 | Buick |
| d-58-I/94-A-11 | Doig | 18.10 | Buick |
| d-68-I/94-A-11 | Doig | 23.90 | Buick |
| d-69-I/94-A-11 | Doig | 22.00 | Buick |
| d-76-I/94-A-11 | Hfwy-Doig | 12.00 | Buick |
|  | Doig | 18.00 | Buick |
| b-77-I/94-A-11 | Doig | 12.10 | Buick |
|  | Doig | 17.10 | Buick |
| d-79-I/94-A-11 | Doig | 9.00 m | Buick |
| d-85-I/94-A-11 | Doig | 36.40 | Buick |
| d-86-I/94-A-11 | ChLk-Doig | 18.10 | Buick |
|  | Doig | 18.20 | Buick |
| (02)d-96-I/94-A- | ChLk | 8.40 m | Buick |
|  | Doig | 27.00 | Buick |
| (03)d-96-I/94-A- | Hfwy-Doig | 41.80 | Buick |
| d-52-J/94-A-11 | Mntny | 18.20 | Regional |
| b-64-I/94-A-12 | Doig | 17.90 | Cache |
| d-06-A/94-A-14 | Hfwy-Doig | 28.00 | Buick |
| a-26-A/94-A-14 | Doig | 22.20 | Buick |
| d-35-A/94-A-14 | Hfwy-Doig | 21.70 | Buick |
| d-58-A/94-A-14 | Hfwy-Doig | 36.00 | Buick |
| b-6-D/94-A-14 | Doig | 15.00 | Fireweed |
| d-15-D/94-A-14 | Doig | 19.00 | Fireweed |
| b-26-D/94-A-14 | Doig | 17.15 | Fireweed |
| d-37-D/94-A-14 | Doig | 16.00 | Fireweed |
| b-56-D/94-A-14 | ChLk-Hfwy | 18.20 | Regional |
| TOTALS: | 40 Wells | 864.8 m |  |

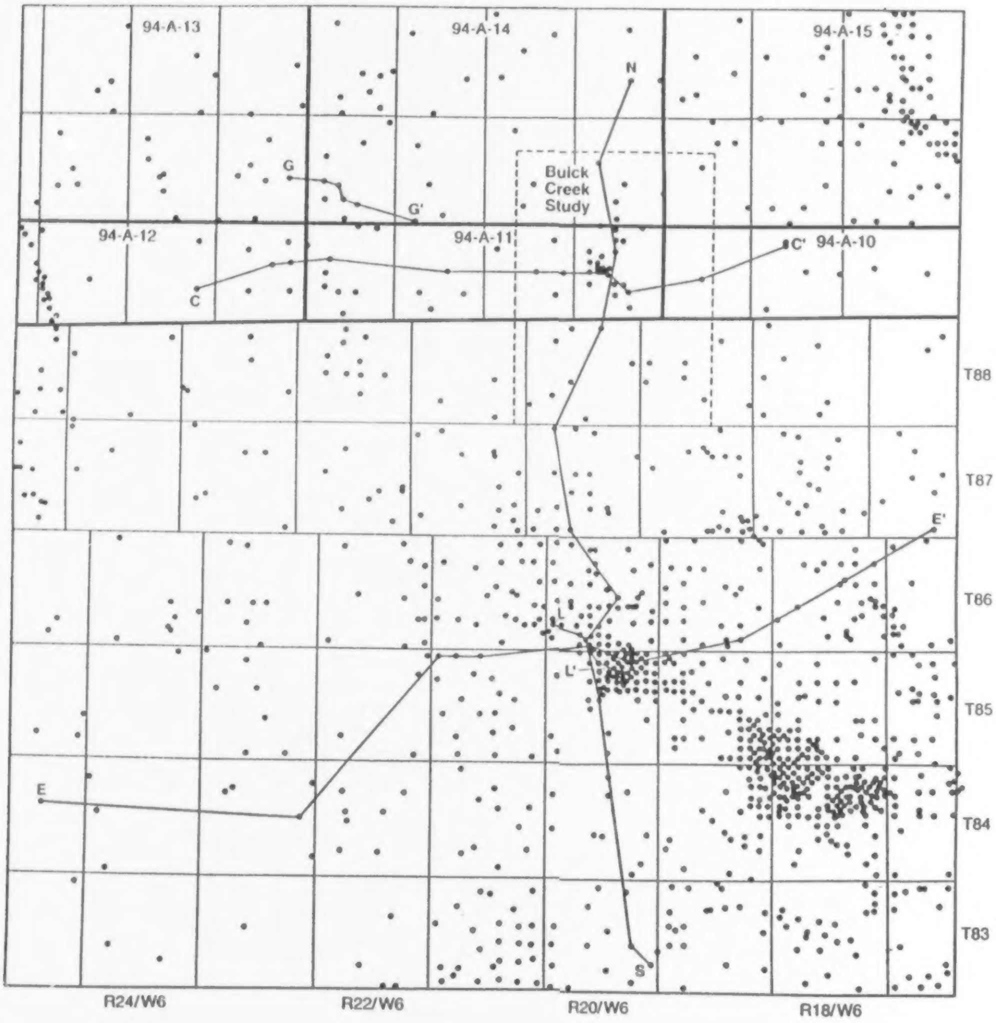

94-A-13
94-A-14
94-A-15
N
G
G'
Buick
Creek
Study
94-A-12
94-A-11
C'
94-A-10
C
T88
T87
E'
T86
L
L'
T85
E
T84
T83
S
R24/W6
R22/W6
R20/W6
R18/W6

Figure 7-2. Study area outline showing all Halfway penetrations in the area. All wells with core recovered from the Doig and/or Lower Halfway intervals have been logged as part of this study (see also Table7-2). Cross sections L-L', G-G', N-S, C-C', and E-E' are discussed in the text and presented as figures 7-6, 7-7 and 7-11 through 7-13 respectively.

TABLE 7-3. Summary of facies characteristics in the Lower Halfway and Doig formations (from Evoy and Moslow, *in press*).

| FACIES | LITHOLOGY | SEDIMENTARY STRUCTURES AND BEDDING GEOMETRY[1] | DEPOSITIONAL PROCESS(ES) | DEPOSITIONAL ENVIRONMENTS[2] |
|---|---|---|---|---|
| A1 | SILTY MUD<br>black,calcareous<br><5 to 10% vfg sand | Plane parallel lamina, rare ripple lamina, discontinuous sand lamina; beds to 6m*. Pl, Pa | SUSPENSION SEDIMENTATION<br>Rare traction currents, turbidites/contourites. | OFFSHORE -<br>Distal Shelf |
| A2 | MUDDY SILT<br><10% vfg sand | Plane parallel lamina, minor ripple lamina, rare convolute beds; coarsens up; sands to 5cm thick, beds to 14m thick; Pa, Pl, Ch, Th(?), As(?), Te(?). | SUSPENSION SEDIMENTATION<br>Minor traction currents, turbidites/tempestites. | OFFSHORE -<br>Proximal Shelf |
| B1 | INTERBEDDED SILT/SAND<br><30% sand | Plane parallel and ripple lamina; occasionally massive or bioturbate; rare HCS(?); Cy, He(?). | MIXED SUSPENSION/TRACTION<br>Sediment gravity flows and rare storm beds. | OFFSHORE |
| B2 | INTERBEDDED SAND/SILT<br>30% to 70% sand | Plane parallel and ripple lamina; occassional to common HCS; locally massive; fugichnia, Cy, Ro. | MIXED TRACTION/SUSPENSION<br>Storm beds. | OFFSHORE TRANSITION |
| C1 | SILTY VERY FINE SAND<br>up to 30% silt | Internally massive to moderate angle cross beds at 15-20°; bed sets to 3m*; locally bioturbate. | TRACTION CURRENTS<br>Aqueous gravity currents. | SHOREFACE -<br>Lower to Middle |
| C2 | FINE to MEDIUM SAND<br><10% silt | Internally massive; rare moderate angle cross beds, planar and (occasional) troughs; locally bioturbate. | TRACTION CURRENTS<br>Aqueous gravity currents. | SHOREFACE -<br>Middle to Upper |
| D1 | CONGLOMERATE<br>pebble/cobble,<br>with sand,silt,shells. | Beds <20cm thick, clasts to 10cm in diameter; no evident grading; abrupt contacts; rare shell fragments. | WAVE RAVINEMENT SURFACE<br>Erosional lag. | TRANSGRESSIVE SURFACE OF EROSION |
| D2 | BIOCLASTIC CONGLOMERATE<br>with sand, silt, and rare granules | Coarse bioclastic conglomerate and coquina; beds typically 20cm to 1.5m thick; rare X-beds at 10-15°; internal scour surfaces; abrupt to erosive contacts. | TRACTION CURRENTS<br>Aqueous gravity currents,<br>Erosional lag. | UPPER SHOREFACE<br>Tidal Inlets(?), TSE Equivalent. |
| E | DISTURBED BEDS | Not a true lithofacies: includes oversteepened bedding and slumps; highly variable to discontinuous. | SOFT-SEDIMENT DEFORMATION | Not Restricted by Environment. |

COMMENTS:

1. As - *Asterosoma*, Cy - *Cylindrichnus*, Pa - *Paleophycus*, Th - *Thalassinoides*, Ro - *Rosellia*, Pl - *Planolites*, He - *Helminthopsis*, Te - *Terebellina*, Ch - *Chondrites*.
2. Shelf refers to deposition below maximum storm wave base; distal and proximal are relative terms.

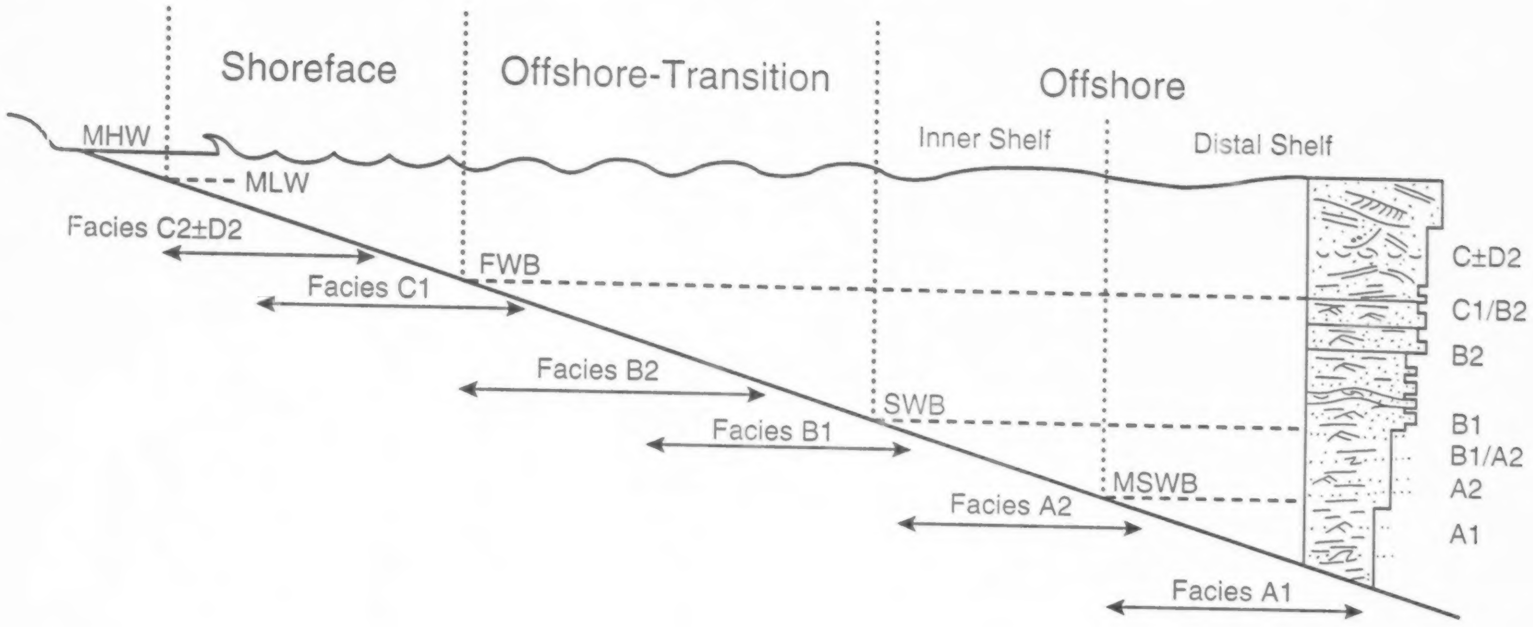

Shoreface
Offshore-Transition
Offshore
Inner Shelf
Distal Shelf
MHW
MLW
Facies C2±D2
FWB
Facies C1
Facies B2
SWB
Facies B1
MSWB
Facies A2
Facies A1
C±D2
C1/B2
B2
B1
B1/A2
A2
A1

Figure 7-3. Facies distributions and depositional environments for the Doig Formation in northeastern British Columbia. (after Elliot, 1986 and Krassay, 1994). FWB - fairweather wave base, SWB - average storm wave base, MSWB - maximum storm wave base.

associations, appearing in each of the fields studied, were recognized and are presented in ascending (stratigraphic) order.

### *Association 1 - Offshore/Shelf*

The basal Doig interval, underlying the Doig Sands, consists of phosphatic siltstone and shale with rare very fine-grained sandstone, and represents deposition under quiet water conditions in an offshore/shelf setting dominated by suspension settling. The suspension sedimentation regime is punctuated by infrequent storm-related traction currents. The overall pattern in this association is a crude coarsening upwards trend, from predominantly shale to predominantly siltstone.

### *Association 2 - Shoreface*

Siltstones and shales of Facies Association 1 are abruptly overlain by shoreface sandstones of Facies Association 2. The basal surface is sharp to erosive, and progressively truncates strata down section in a basinal direction. This surface is frequently mineralized, weakly scoured, and may be marked by a thin shale rip-up lag. Facies Association 2 consists of very fine- to medium-grained, massive to crossbedded sandstone, and locally coquina, interbedded with subordinate siltstone. Deposition represents traction sedimentation in lower through upper shoreface settings. Where present, the shoreface association is generally less than 15 m thick, but may be up to 30 m thick locally. This unit thins rapidly both up and down depositional dip, and is capped by Facies D conglomerates.

### *Association 3 - Offshore Transition*

Facies Association 3 consists primarily of interbedded siltstone and very fine-grained sandstone, coarsening-up into hummocky crossbedded fine-grained sandstone. This association is similar in part to the offshore/shelf association (Facies Association 1), but can be differentiated based on stratigraphic position, increased sand content and prevalance of hummocky cross-stratification up section, and a change in the trace fossil assemblage from a distal *Cruziana* ichnofacies (dominated by horizontal elements) to a hybrid of the *Cruziana* and *Skolithos* ichnofacies (with an increasing component of vertical elements).

## Doig Sand Body Geometries

### *Buick Creek*

The Buick Creek Field in northeastern British Columbia (Figure 7-2) represents the largest recognized Doig reservoir in the Fort St. John area. Since the discovery of the Doig B pool in 1976, a total of 5 oil pools (2 with economic associated gas) have been discovered. Initial in-place volumes exceed 3 million $m^3$ oil (~20 million bbls), with 350 million $m^3$ gas (12.5 bcf). Average net oil pay is approximately 7 m with porosities about 10%; average gas pay and porosity is approximately 4 m and 8.5%. Water saturation levels are low, and the oil is a light crude. All production is from Facies Association 2.

Although the Doig reservoir at Buick Creek has been subdivided into a number of different productive pools, along-strike correlations clearly demonstrate that these represent a single stratigraphic horizon (CHAPTER 6). Net sand distribution clearly defines a pronounced linear pattern, oriented subparallel to the inferred paleoshoreline and normal to depositional dip (Figure 7-4). Length of the main sandstone body along depositional strike exceeds 19 km, and is unconstrained to the north. Dip dimensions are variable, but average less than 2 km. Sandstone thickness is irregular along strike, varying from less than 5 m to greater than 25 m. This sandstone is referred to herein as the 1st Doig Sand to differentiate it from other Doig sandstones that may occur at different stratigraphic levels.

Facies changes in the Buick Creek area are abrupt, both vertically and laterally. The sandstones of Facies Association 2 abruptly overlie offshore siltstones and shales (Facies Association 1) across an erosive contact. This succession represents a significant basinward shift in facies, and development of a lowstand shoreface. We interpret this surface as a regressive surface of marine erosion (*cf* Nummendal *et al.*, 1993), or a subaqueous ravinement surface. This surface represents the marine expression of a lowstand surface of erosion and likely reflects a tectonically induced fall in relative sea level (CHAPTER 6). The

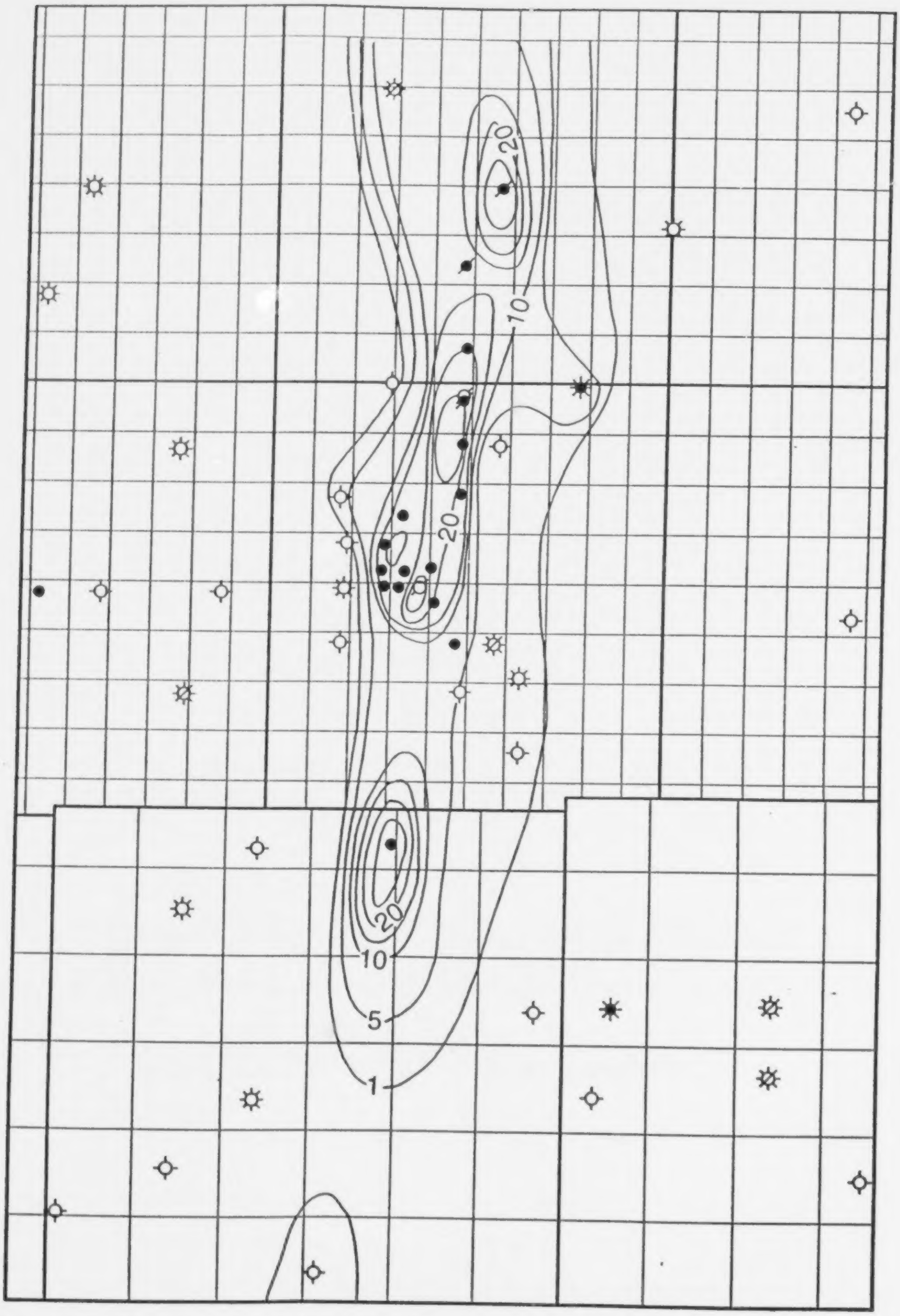


Figure 7-4. Net sand isopach for Facies Association 2 at Buick Creek. Where no core is available, gamma-ray log sand cut-off equals 60° API based on log-core correlation (from Evoy and Moslow, *in press*).

shoreface sandstones are erosionally overlain by a coarse lag deposit, followed by much finer-grained offshore to offshore transition sediments. The lag represents a transgressive surface of erosion (TSE) which amalgamates with the regressive surface of marine erosion (RSME) in a landward direction. The transgressive lag is overlain by a marine flooding surface and a single retrogradational parasequence which onlaps the amalgamated TSE/RSME landward (eg CHAPTER 6, Figure 6-9a).

### *Stoddart-West*

Doig production from the Stoddart - West field consists of three small pools, each less than 200 ha, with combined reserves of approximately 300,000 $m^3$ of oil (2 million bbls). The largest of the 3 pools is the Doig B Pool with 240,000 $m^3$ (1.5 million bbls), 2.0 m net pay, and 10% porosity. The producing sandstone lies along the extension of the main trend at Buick Creek, and represents the strike equivalent of the 1st Doig Sand at Buick Creek.

The prospective Doig horizon has been cored in 3 wells in the Stoddart - West area, and is productive in both cored wells from the B Pool. Two regional Doig cores have also been recovered in the immediate vicinity, for a total of 80 m of available core. This area, however, is the focus of significant Belloy production; consequently a large wireline log database is available. One hundred and twenty seven wells penetrate the entire Doig interval within a 5 km radius of the Stoddart - West trend.

Facies Association 1 in the Stoddart - West B Pool is a plane-parallel laminated, weakly calcareous, silty shale to muddy siltstone unit. Rare very fine-grained sand lamina are present as starved ripples and convolute laminations, and locally exhibit microfaulting and pyritic lamina (Figure 7-5). Burrowing is generally weak and consists predominantly of *Planolites*, *Helminthopsis* and *Anchonicnus*. This interval represents deposition from suspension, punctuated by rare low-density turbidity current deposition.

Facies Association 2 at Stoddart-West, where cored, is similar in appearance to the

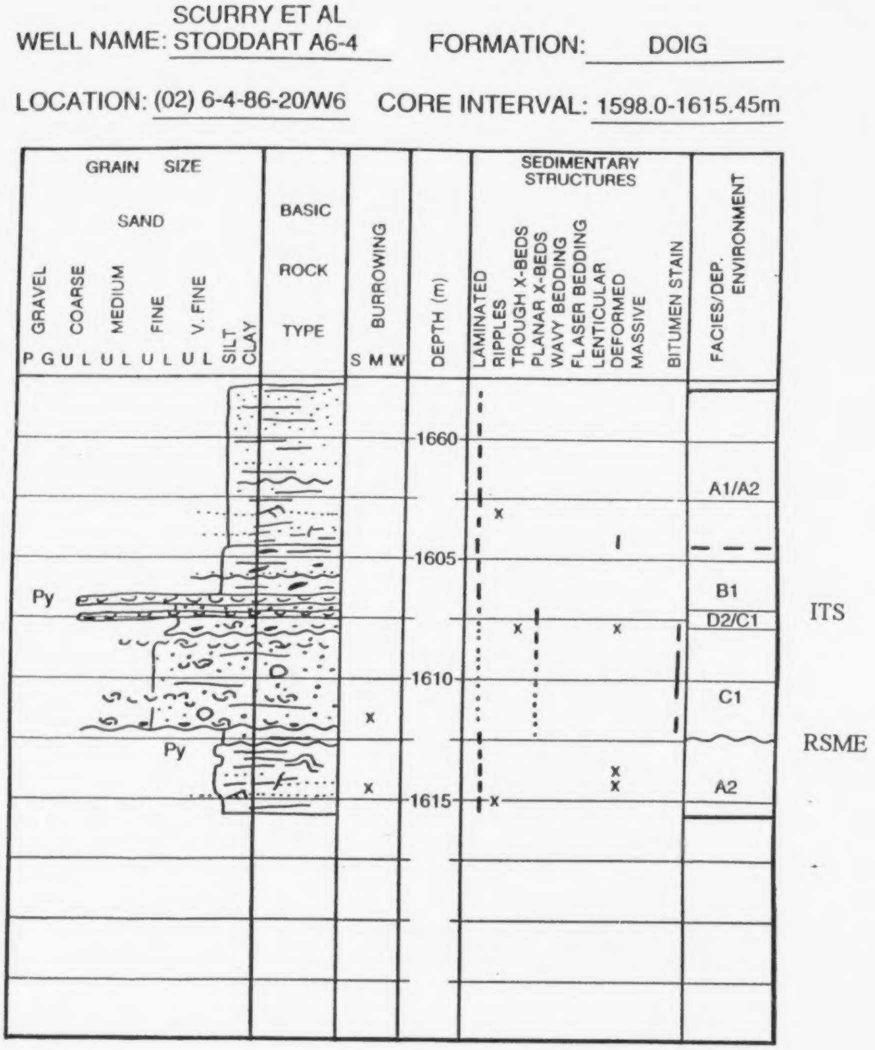

SCURRY ET AL
WELL NAME: STODDART A6-4
FORMATION: DOIG
LOCATION: (02) 6-4-86-20/W6
CORE INTERVAL: 1598.0-1615.45m
GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH (m)
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BITUMEN STAIN
FACIES/DEP. ENVIRONMENT
1660
1605
1610
1615
Py
Py
A1/A2
B1
D2/C1
C1
A2
ITS
RSME

Figure 7-5. Graphic core log description for Scurry et al Stoddart (02)6-4-86-20/w6.

sandstone at Buick Creek. The sandstone is fine- to very fine-grained, dolomitic, and contains minor shelly debris; discrete bioclastic beds are volumetrically insignificant and restricted to the uppermost portion of this unit. Internally, the sandstone is generally structureless or massive bedded with minor shale partings and poorly developed low angle, planar tabular cross-beds. Burrowing is weak, and was only identified in the basal portion of cored intervals immediately overlying the basal contact where a limited assemblage of thin walled, collapsed *Paleophycus tubularis* burrows are present. The oversteepening noted at Buick Creek is not significant at Stoddart - West, and is limited to one discrete sandstone bed approximately 25 cm thick in well (02)6-4-86-20/w6 (Figure 7-5). Thickness of this unit does not exceed 6 m in the B Pool.

The base of the sandstone at Stoddart - West is sharply demarcated in wireline logs, and can be correlated to core in the Doig B Pool. The basal contact in core is sharp, weakly erosive, and contains rare rip-up clasts and shell debris. Locally, this contact is marked by a *Glossifungites* surface in well 12-04-86-20/w6. The erosive nature of the lower contact is evident in cross section and is highlighted by slight truncation of the uppermost phophate beds (Figure 7-6). This contact represents a significant basinward shift in facies across a marine ravinement surface which represents a regressive surface of marine erosion equivalent to that identified at Buick Creek.

The upper contact of the Doig Sand in the B Pool is marked by two thin (10 cm), normally graded, bioclastic units with sharp contacts, up to 10% coarse sand-sized phosphatic clasts, and disseminated pyrite. This surface coincides with a dramatic change in gamma-ray log signature as well as a pronounced change in lithology (Figures 7-5 and 7-6), and represents the initial transgressive surface. The sandstone is overlain by 2 m of a coarse siltstone with minor coarse sand-sized phosphate clasts, then fines upward into plane-parallel laminated muddy siltstone with rare, poorly developed ripples. The entire interval is marked by numerous small scale erosional discontinuities. These sediments are assigned to Facies Association 3.

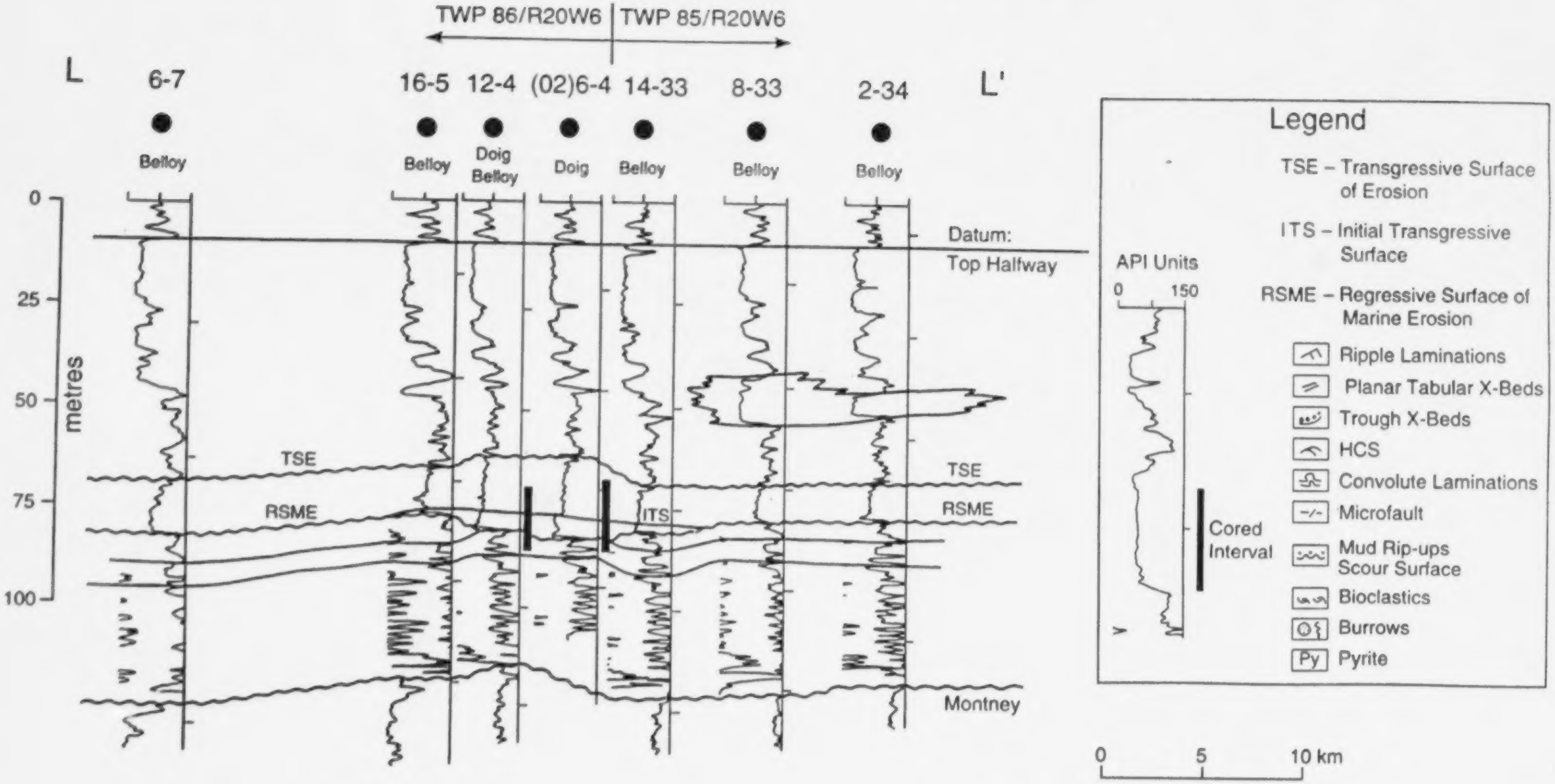


Figure 7-6. Gamma-ray dip section L-L' through the Stoddart-West field. Solid black bars represent intervals with core control. TSE - transgressive surface of erosion, ITS - initial transgressive surface, RSME - regressive surface of marine erosion. Location shown on Figure 7-2.

The flooding event associated with the initial transgressive surface is sudden, but spatially restricted to the southern portion of the study area. As a result, Stoddart - West is the only Doig pool in which sediments assigned to Facies Association 3 have been found beneath the Transgressive Surface of Erosion (Figure 7-6). In the Stoddart-West B Pool, all production is from Facies Association 2 below the initial transgressive surface.

The regional expression of the Transgressive Surface of Erosion, as determined from well log signature and cross section correlations, has not been cored in the B Pool. Where it has been cored adjacent to the pool, this surface is marked by 10 cm of coquina (16-15-86-20/w6). The Facies Association 2 sandstones and their basal contact are also progressively truncated landward by the overlying Transgressive Surface of Erosion.

The general absence of hummocky cross stratification and paucity of storm beds suggests that Facies Association 3 in the the Stoddart - West area may have accumulated under slightly deeper water conditions than at Buick Creek. This may reflect renewed subsidence along the flank of the Fort St. John Graben, and provides support for the contention that sea level fluctuations are tectonically modified in the area.

### *Cache Creek/Fireweed*

A second Doig sandstone is present in the Cache Creek and Fireweed fields, 10 to 20 km basinward of the Buick Creek/Stoddart-West trend. At Cache Creek, the Doig A Pool contains an in place volume of 282 Mm$^3$ gas (10 bcf). Net gas pay is 6.3 m, porosity 9.1%, but assigned recovery factor is only 0.20%. There is no obvious sedimentologic explanation for such poor recovery.

At Fireweed, there are two 1-well oil pools, each with significant associated gas. The Doig A Pool contains in place volume of 80,000 m$^3$ light oil (500,000 bbls) with 44 Mm$^3$ associated gas (1.5 bcf). Net oil pay is 15.5 m with 9% porosity. The Doig B Pool is smaller, with 29,000 m$^3$ oil (180,000 bbls) and 60 Mm$^3$ associated gas (2.1 bcf). Net oil pay is 5.6 m with 9% porosity.

The Doig Sand interval has been penetrated in 24 wells in the Cache Creek/Fireweed area. Nine of the wells encountered less than 3 m of sandstone, and 7 wells had no sandstone. The sandstone has been cored in 3 wells. Each of these cored intervals penetrated the basal sandstone contact, one at Cache Creek and 2 at Fireweed. Two addition wells cored the stratigraphic position of the Doig Sand at Fireweed, but did not encounter any sandstone; one of these (d-37-D/94-A-14) cored the stratigraphic equivalent of the upper contact of the Doig Sand. No significant core recovery is available in the overlying assemblage.

The basal Doig in the Cache Creek and Fireweed areas is a dark, calcareous, muddy siltstone with <5 to 10% admixed, very fine-grained sand. Bedding consists of fine plane-parallel laminations with minor silty pyritic laminations. Rare very fine-grained sand laminae may exhibit convolute laminations, thin ripples or small-scale microfaults. Burrowing is weak, to locally moderate. Identified traces are all simple horizontal elements, and consist primarily of *Anchonicnus*, *Chondrites*, *Helminthopsis* and *Planolites*, with rare *Paleophycus*. This unit is equivalent to Facies Association 1 in the Buick Creek area, and represents a distal shelf environment well below the influence of any storm wave activity.

There is a weak coarsening up in the upper 1 to 2 m of Facies Association 1 in some wells, and in such cases this interval may include an increase in convolute laminations and microfaulting relative to their underlying intervals. The basal contact between the Doig Sand and this underlying unit is sharp (Figure 7-7) and locally pyritized. In core, this contact is similar to the expression of the regressive surface of marine erosion in cores from Buick Creek and Stoddart-West (Figure 7-8).

The Doig Sand in both pools is a lower fine-grained, massive to cross-bedded sandstone, with high-angle planar tabular cross beds at 15° to ~30° in poorly defined decimetre-scale bed sets. Erosive based, massive, upper fine- to medium-grained sandstones

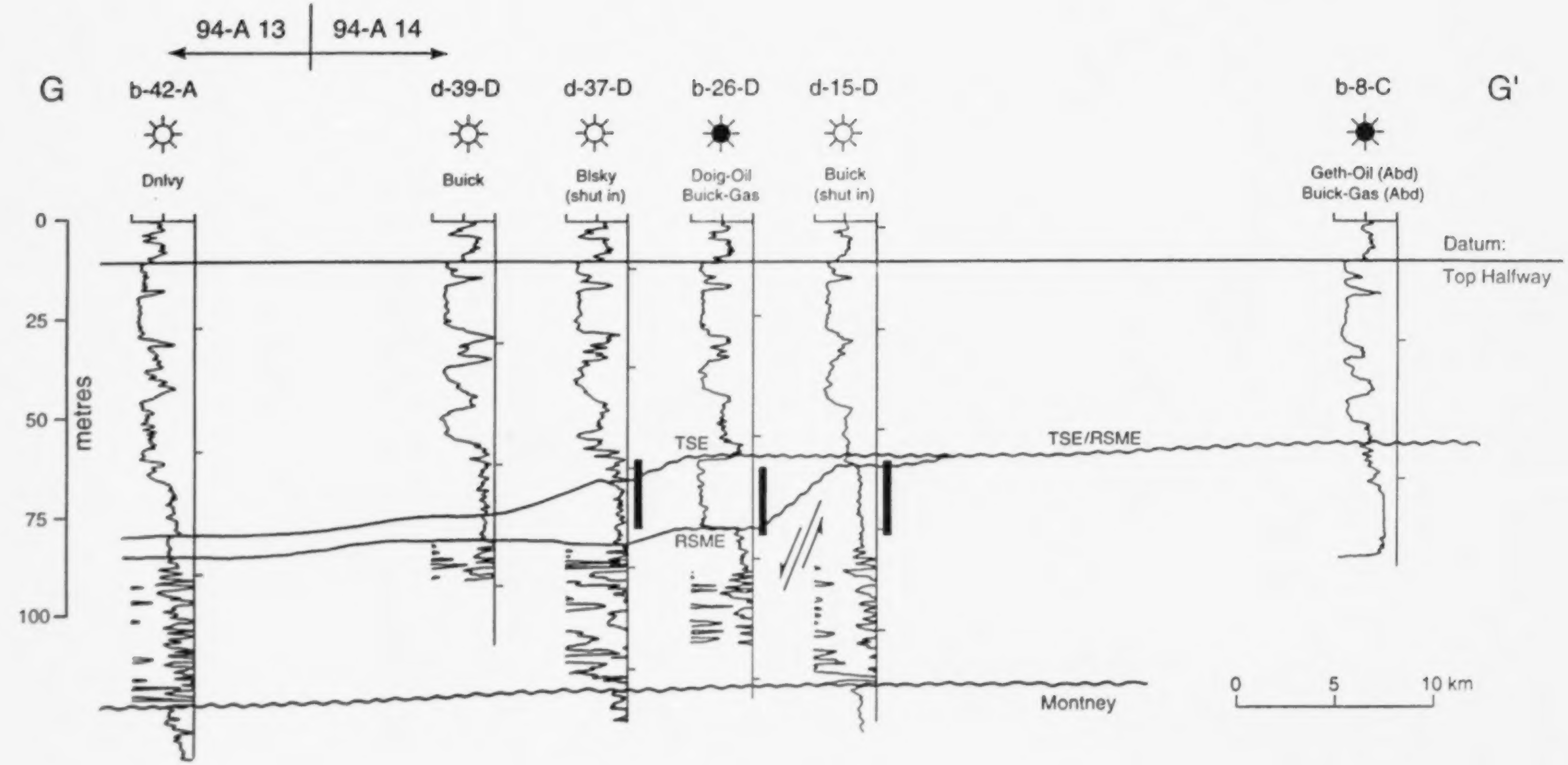

94-A 13
94-A 14
G
G'
b-42-A
d-39-D
d-37-D
b-26-D
d-15-D
b-8-C
Dnlvy
Buick
Blsky (shut in)
Doig-Oil Buick-Gas
Buick (shut in)
Geth-Oil (Abd) Buick-Gas (Abd)
0
25
50
75
100
metres
Datum:
Top Halfway
TSE
TSE/RSME
RSME
Montney
0
5
10 km

Figure 7-7. Gamma-ray dip section G-G' through the Fireweed field. Solid black bars represent intervals with core control. TSE - transgressive surface of erosion, ITS - initial transgressive surface, RSME - regressive surface of marine erosion. Location shown on Figure 7-2.

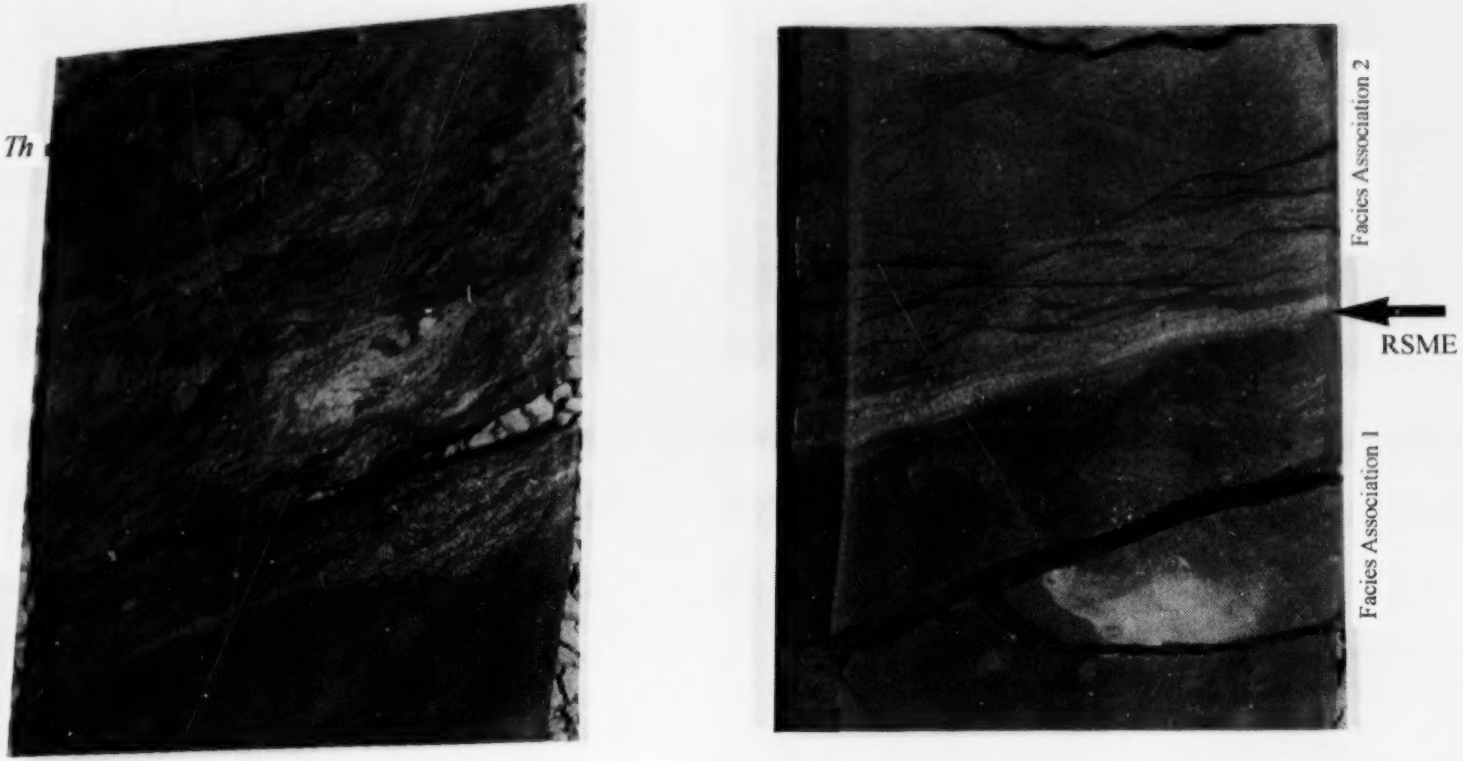

Th
Facies Association 2
RSME
Facies Association 1

Figure 7-8. Core photographs of Facies Association 2. All cores 10 cm wide, slabbed width approximately 9 cm.
A). Base of Facies Association 2 at Cache Creek (b-64-I/94-A-12). Note robust Thalassinoides burrows.
B). Base of Facies Association 2 at Buick Creek (d-06-A/94-A-14).

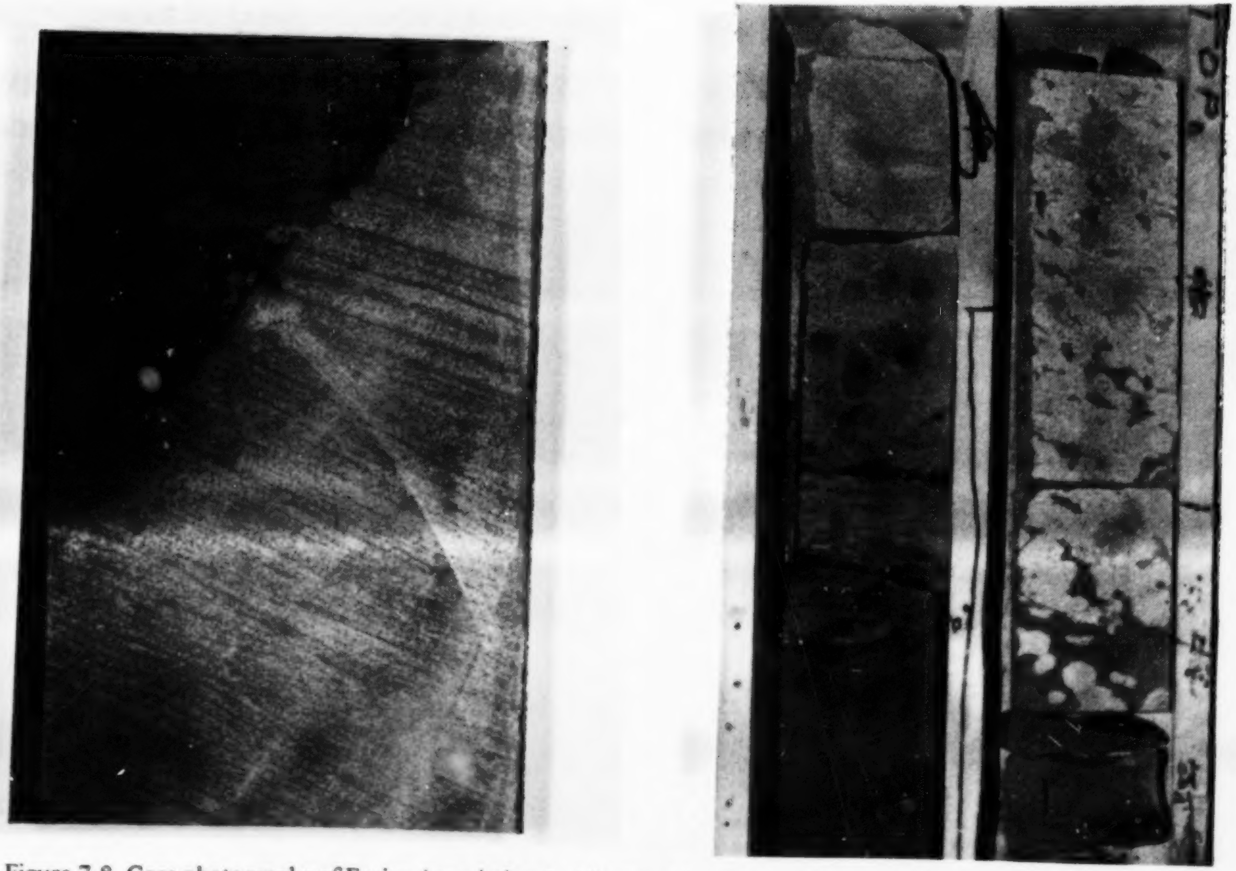


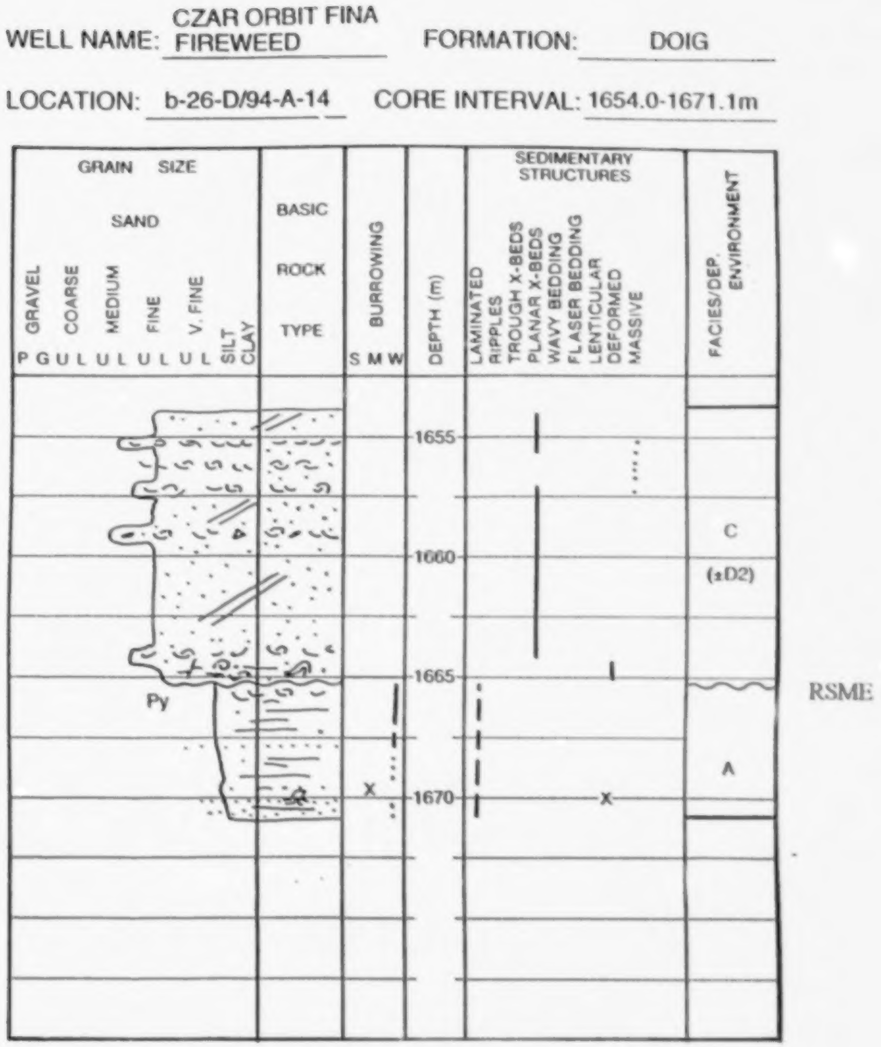
Figure 7-8. Core photographs of Facies Association 2. All cores 10 cm wide, slabbed width approximately 9 cm.
C). Core b-64-I/94-A-12 at 1646.15 m. Note control of cement type over cross-bedding inclination (arrow).
D). Base of Facies Association 2 in the Fireweed field (b-26-D/94-A-14). Note nodular calcite cementation (light grey) at top of core box.

in beds up to 10 cm thick are present locally, and may contain significant shelly debris and/or biomoldic porosity. Minor bioclastic-rich intervals or lags, and rare mud rip-ups are also present.

The Doig Sand is variably calcite cemented or bitumen stained, giving the core a mottled light and dark grey colouration pattern. The darker bitumen stained intervals are dolomite cemented. Cross bedding inclination can be seen to change with the change in cement composition (Figure 7-8C). There is no stratal dislocation associated with this change in bedding orientation; consequently this must represent structural disturbance prior to complete lithification.

The thickest sandstone recovered in core from this area is the discovery well for the Fireweed Doig A Pool (Figure 7-9). The Doig Sand here is 17 m thick, and the basal 11 m have been cored. The reservoir here is a lower to upper fine-grained sandstone with five discrete bioclastic and/or biomoldic intervals 10 to 50 cm thick. Sandstone beds are variably cross bedded with medium angle planar tabular cross beds at ~15°. Locally these inclinations steepen to greater than 20° to 25° in association with the presence of light grey calcite cement. Bioclastic bed contacts are obscured by intense calcite cementation, but are locally gradational over a 1 to 2 cm interval. Mud rip-up clasts are a minor constituent of all these intervals (Figure 7-9), and rare siderite clasts are present locally.

There is little evident burrowing within these sandstones, but a pronounced centimetre-scale 'nodular' calcite cementation pattern near the base of the Doig Sand in well b-26-D/94-A-14 at Fireweed may reflect alteration centered on a network of *Thalassinoides* burrows (Figure 7-8D). A similar interpretation has been postulated for analogous cementation patterns at Buick Creek (CHAPTER 6, Figure 6-4). Rare *Thalassinoides* burrows of a size compatible with that of this alteration pattern are present near the base of the Doig Sand at Cache Creek (Figures 7-8A).



WELL NAME: CZAR ORBIT FINA FIREWEED
FORMATION: DOIG
LOCATION: b-26-D/94-A-14
CORE INTERVAL: 1654.0-1671.1m

GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH (m)
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
FACIES/DEP. ENVIRONMENT
1655
1660
1665
1670
Py
X
C
(±D2)
A
RSME

Figure 7-9. Graphic core log description for Czar Orbit Fina Fireweed b-26-D/94-A-14.

The stratigraphic equivalent to the upper contact of the Doig Sand has been cored in d-37-D/94-A-14. This interval consists of a 5 m thick interval of interbedded bioclastic conglomerate or sandy, dolomitic rudstone, interbedded with sandy siltstone containing a minor constituent of finely comminuted bioclastic debris. The coarse bioclastic units predominate in beds up to ~75 cm thick. Beds exhibit erosive bases and either sharp or gradational tops.

One intensely deformed bioclastic unit 30 cm thick was noted. This zone superficially resembles features of load induced soft sediment deformation with bed contacts near parallel to the core axis, and was initially interpreted as either a slump or fluidization phenomena. Reexamination of this interval revealed a thin, centimetre-scale polished black "mud" coating containing fine, contact-parallel calcite veins along the slump edges. This is now inferred to represent tectonically induced deformation. The entire bioclastic interval lies directly over Facies Association 1 across an erosional contact, and is overlain by a flooding surface which is marked by approximately 70 cm of silty shale. This latter represents the only core recovered from the overlying assemblage.

A net sand isopach of the Doig Sand in the Fireweed and Cache Creek field areas reveals a pronounced regional linear trend oriented northwesterly, subparallel to the inferred paleoshoreline. The continuity of this pattern is abruptly broken in the vicinity of Cache Creek where there is a sudden translation of the trend to the southwest to encompass the Cache Creek Field. Here the trend becomes lobate in character, and total sandstone thicknesses are reduced from greater than 15 m to 7.5 m.

The Doig Sand in this area is informally referred to herein as the 2nd Doig Sand to differentiate it from the sandstone in the Buick Creek/Stoddart-West areas, and is interpreted as a second lowstand shoreface based on its abrupt erosive base, wireline log characterization, and sedimentologic similarity to Buick Creek. There is an abrupt updip edge to the sandstone (Figure 7-7) and a pronounced asymmetry about the axis of maximum sand thickness (Figure

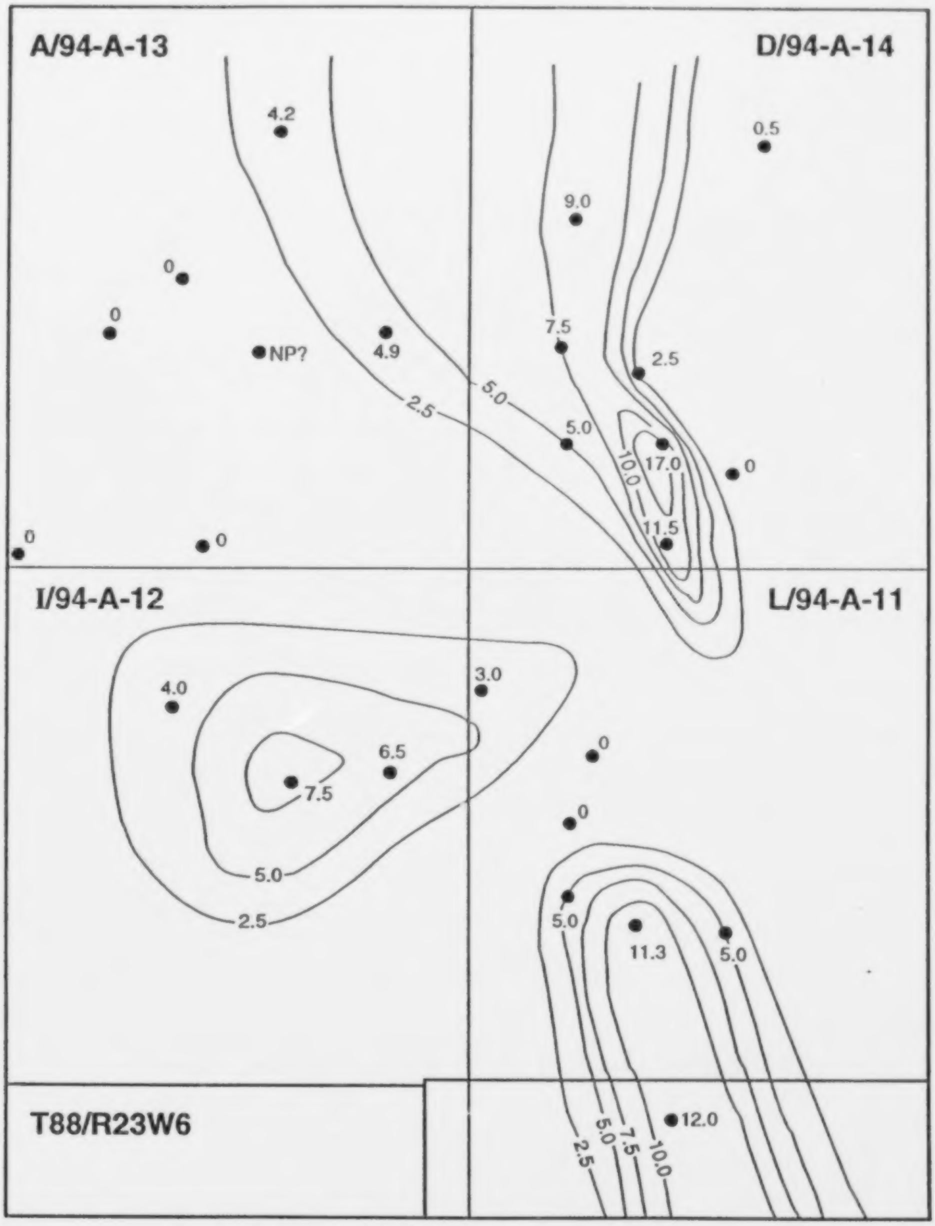

A/94-A-13
D/94-A-14
I/94-A-12
L/94-A-11
T88/R23W6
4.2
0.5
9.0
0
0
NP?
4.9
7.5
2.5
5.0
2.5
5.0
17.0
10.0
0
11.5
0
0
4.0
3.0
6.5
7.5
0
0
5.0
2.5
5.0
11.3
5.0
12.0
2.5
5.0
7.5
10.0

Figure 7-10. Net sand isopach for Facies Association 2 (2nd Doig Sand) in the Fireweed/ Cache Creek area. Gamma-ray log sand cut-off equals 60° API as determined in Evoy and Moslow (*in press*).

7-10). Sedimentologic data to further define the depositional environments are not available. The Cache Creek sand may simply represent shoreface failure due to a number of factors including storm wave loading, rapid sediment loading, and underconsolidation. Alternatively, the isopach trend is suggestive of a possible barrier island system present both at Fireweed and south of Cache Creek (Figure 7-10). The down-dip displacement of the isopach trend at Cache Creek may represent an associated ebb-tidal delta.

### Regional Shoreface Trends

The Doig Sand in the Fort St. John area of northeastern British Columbia is preserved as a series of long, linear sandstones oriented subparallel to the paleoshoreline (Figures 7-4 and 7-10). These sandstones form narrow reservoirs, asymmetrically distributed about their axes of maximum sand accumulation, and are rapidly truncated landward by a wave ravinement surface or transgressive surface of erosion. The sandstones define regionally persistent, stratigraphically distinct trends, but individual sandstone bodies exhibit irregular thickness along strike.

Doig sandstones from four different fields show similar patterns in distribution of facies and facies associations. The sandstones (Facies Association 2) are typically very fine- to fine-grained, and are massive to planar tabular cross-bedded in bed sets up to 30 cm thick. Variably bedded bioclastic intervals are a significant component of the sandstones locally. These sandstones are interpreted to represent deposition in a lower-middle through upper shoreface environment. Stratigraphic position suggests that these sandstones are lowstand shorefaces and represent a portion of the Lowstand Systems Tract.

Facies Association 2 sandstones disconformably overlie offshore/shelf siltstones and shales with rare sandstone interbeds (Facies Association 1) which are attributed to the Transgressive Systems Tract and early Highstand Systems Tract (Figures 7-6 and 7-7). The contact between Facies Association 2 and Facies Association 1 is abrupt (Figure 7-8), locally truncates markers in the underlying assemblage across a regressive surface of marine erosion

(Figure 7-6), and is locally demarcated by development of a *Glossifungites* surface. This erosional surface represents the marine equivalent of a lowstand surface of erosion.

The Facies Association 2 sandstones are truncated by a regional Transgressive Surface of Erosion which is overlain by offshore-transition siltstones and silty sandstones punctuated by numerous storm beds (Facies Association 3). A pronounced transgressive lag deposit is present locally along this bounding discontinuity, and is especially well preserved in the Buick Creek field (Chapter 6, Figure 6-6).

The Doig Sand in the Buick Creek/Stoddart-West area is referred to as the 1st Doig Sand for the purpose of differentiating between other stratigraphically distinct sandstones. The 1st Doig Sand trend and its bounding discontinuities can be traced for a minimum 75 km along strike. The trend does not represent continuous clean sandstone, but a number of discrete sandstone bodies, all showing the same general orientation, are preserved locally (Figure 7-11). This discontinuous preservation likely reflects the nature of the original sand distribution. Sand accumulation is spatially associated with breaks in slope in the underlying subaqueous ravinement surface, implying an element of tectonic control over sandstone distribution. Similar breaks in slope are evident along the Doig/Montney contact (Figures 7-12, 7-13 and 7-14), but are generally more subdued. This implies that structural controls on sand deposition and preservation must be in part syndepositional.

At least two separate sandstones have been recognized. The 2nd Doig Sand is recognized in the Fireweed/Cache Creek area (Figure 7-15). This sandstone is 10 to 20 km basinward of, and stratigraphically overlies, the 1st Doig Sand (Figures 7-13 and 7-14). This sandstone exhibits pronounced similarities to the 1st Doig Sand in terms of its sedimentologic characteristics, facies distributions, and bounding discontinuities, and is interpreted as a second lowstand shoreface. Data control becomes progressively more limited in a basinward direction; consequently, the 2nd Doig Sand is less well constrained than the 1st Doig Sand. Minimum strike continuity for the trend exceeds 70 km, and is unconstrained in both

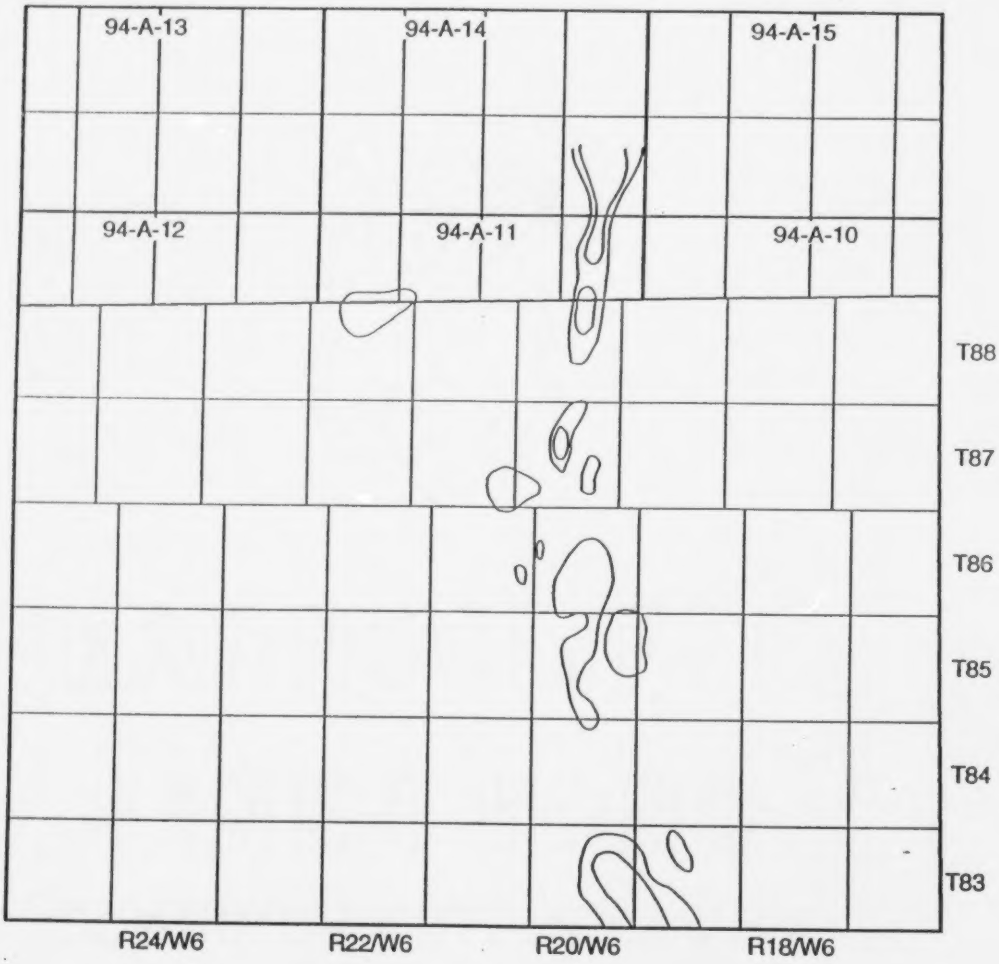

94-A-13
94-A-14
94-A-15
94-A-12
94-A-11
94-A-10
T88
T87
T86
T85
T84
T83
R24/W6
R22/W6
R20/W6
R18/W6

Figure 7-11. Net sand isopach for the 1st Doig sand in the study area. Contours represent the 3 and 10 metre intervals (yellow and red, respectively).

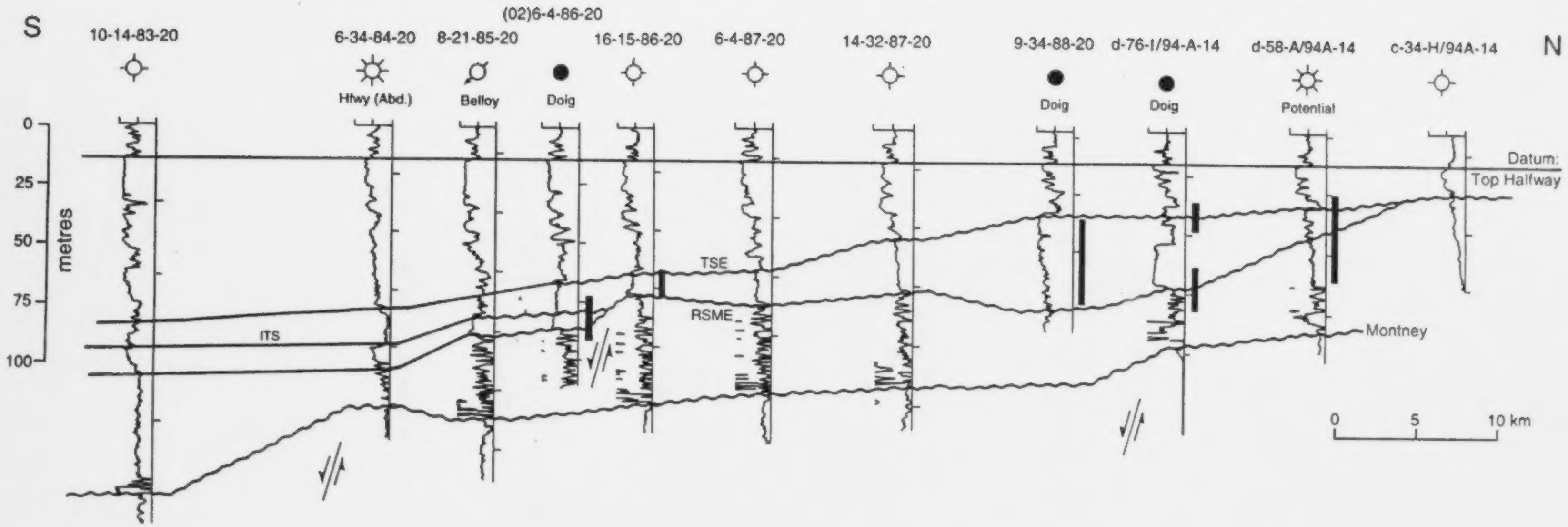

S
10-14-83-20
6-34-84-20
Hfwy (Abd.)
8-21-85-20
Belloy
(02)6-4-86-20
Doig
16-15-86-20
6-4-87-20
14-32-87-20
9-34-88-20
Doig
d-76-I/94-A-14
Doig
d-58-A/94A-14
Potential
c-34-H/94A-14
N
0
25
50
75
100
metres
Datum:
Top Halfway
TSE
RSME
ITS
Montney
0
5
10 km

Figure 7-12. Regional stratigraphic strike section N-S along the Buick Creek/Stoddart-West sand trend (1st Doig sand). Note abrupt thickening of the basal Doig to the south, reflecting subsidence of the Peace River Arch. See Figure 7-2 for location, Figures 7-6 and 7-7 for key to abbreviations.

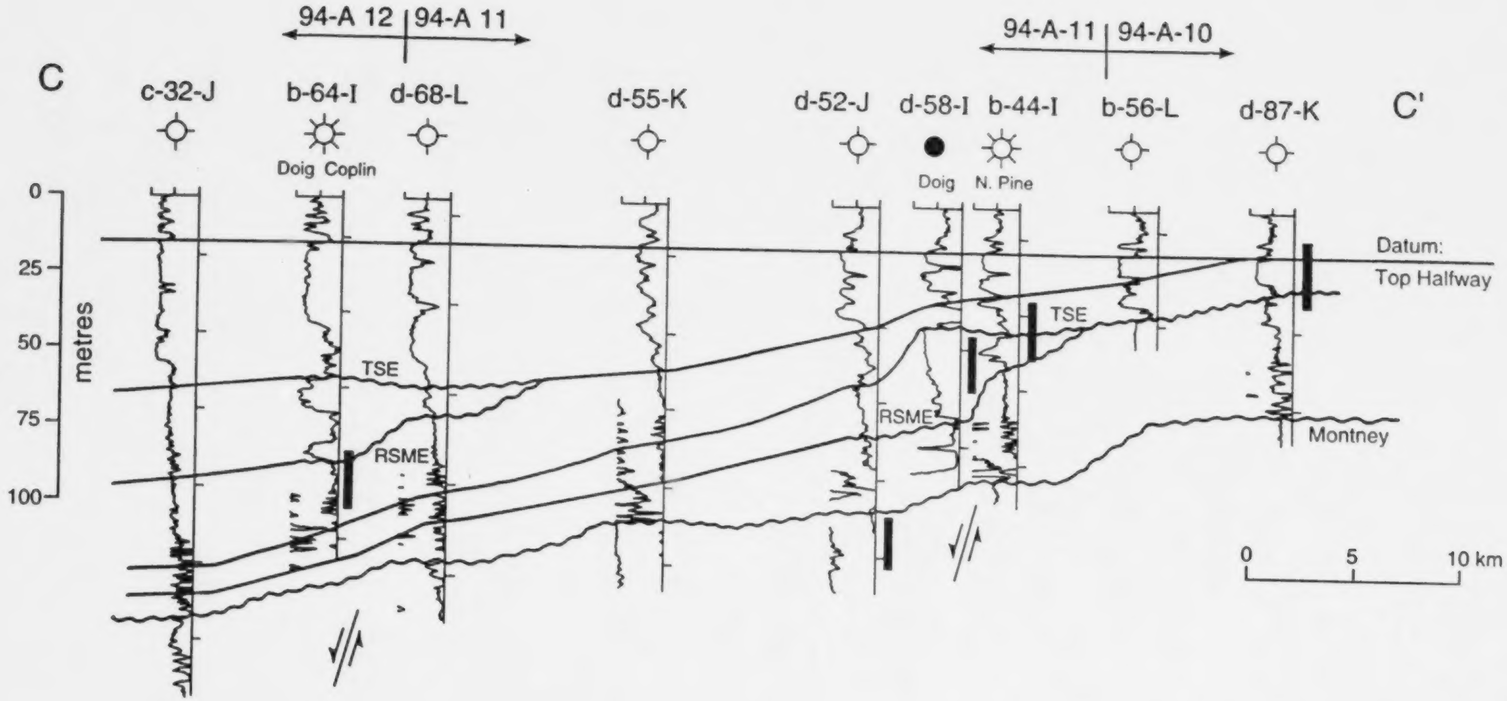

94-A 12 | 94-A 11
94-A-11 | 94-A-10
C
C'
c-32-J
b-64-I
d-68-L
d-55-K
d-52-J
d-58-I
b-44-I
b-56-L
d-87-K
Doig Coplin
Doig
N. Pine
0
25
50
75
100
metres
Datum:
Top Halfway
TSE
RSME
TSE
RSME
Montney
0
5
10 km

Figure 7-13. Regional gamma-ray dip section C-C' through the Cache Creek and Buick Creek field areas. Solid black bars represent intervals with core control., See Figure 7-2 for location, Figures 7-6 and 7-7 for key to abbreviatons.

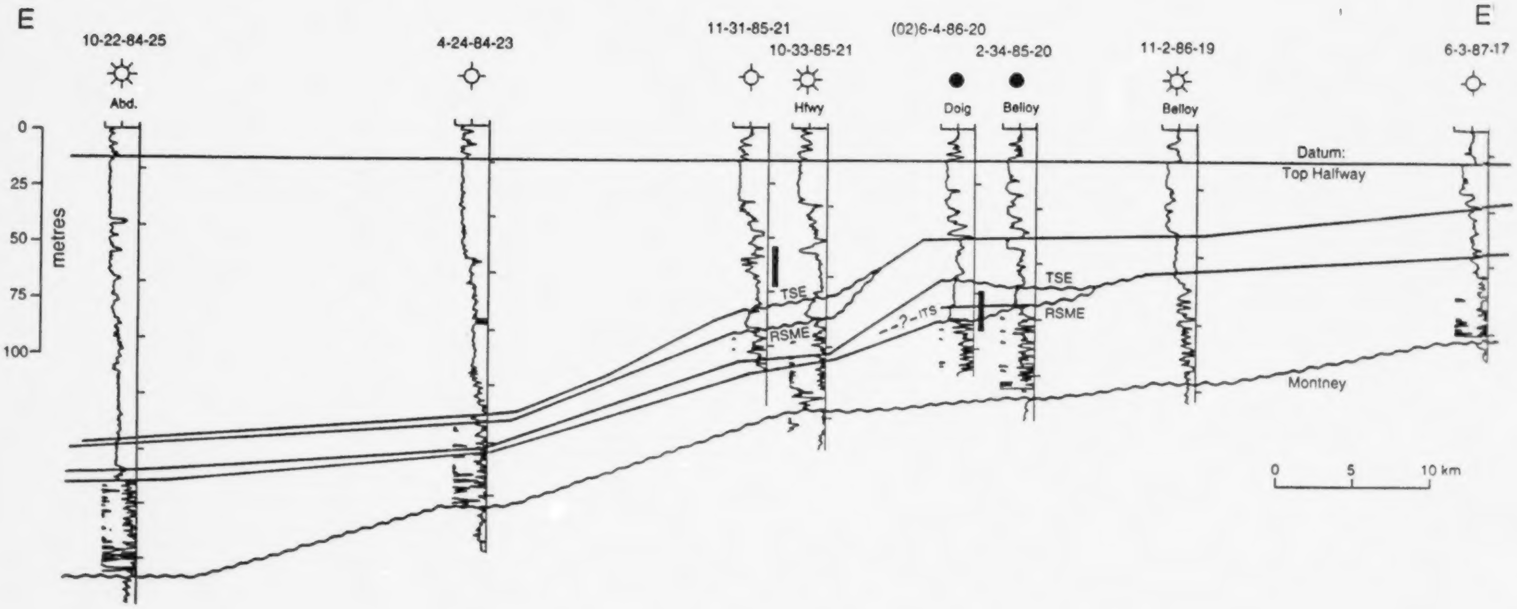

E
10-22-84-25
Abd.
4-24-84-23
11-31-85-21
10-33-85-21
Hfwy
(02)6-4-86-20
Doig
2-34-85-20
Belloy
11-2-86-19
Belloy
6-3-87-17
E'
0
25
50
75
100
metres
Datum:
Top Halfway
TSE
RSME
--?--ITS
TSE
RSME
Montney
0
5
10 km

Figure 7-14. Regional gamma-ray dip section E-E' through the Red Creek and Stoddart-West areas. Solid black bars represent intervals with core control. See Figure 7-2 for location, Figures 7-6 and 7-7 for key to abbreviatons.

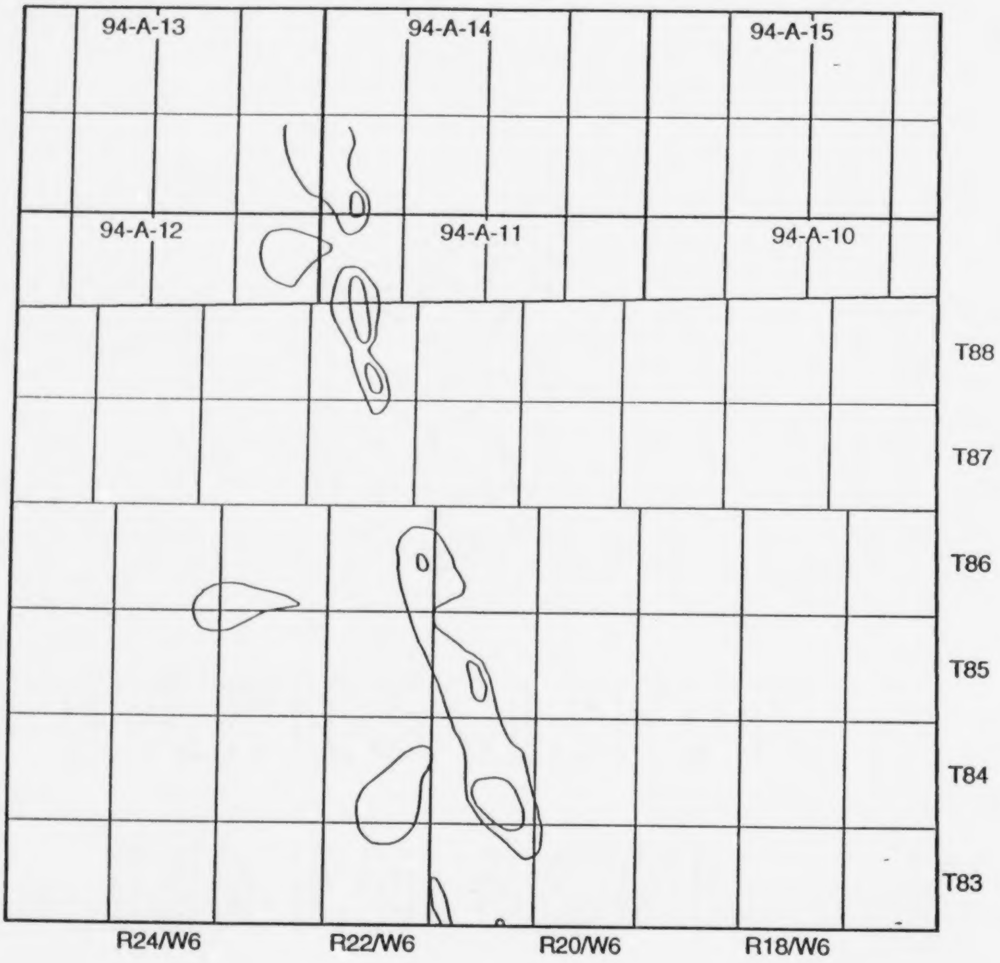

94-A-13
94-A-14
94-A-15
94-A-12
94-A-11
94-A-10
T88
T87
T86
T85
T84
T83
R24/W6
R22/W6
R20/W6
R18/W6

Figure 7-15. Net sand isopach for the 2nd Doig sand in the study area. Contours represent the 3 and 10 metre intervals (yellow and red, respectively).

directions (Figure 7-15).

## Sequence Stratigraphic Implications and Exploration Considerations

### *Implications of High-frequency/High-resolution Sequence Stratigraphy*

Sequence stratigraphic concepts are independant of both time and scale (Posamentier *et al.*, 1992b; Koss *et al.*, 1994), although the type of signature developed may be rate dependant (Wood *et al.*, 1993). Sequences can occur at any scale, and can be grouped into larger scale packages of sequences, composite sequences (Mitchum and Van Wagoner, 1991), or sequence sets (Brink *et al.*, 1994).

There is a strong degree of parallelism apparent in the orientation of the 1st and 2nd Doig Sands (Figures 7-14 and 7-15). The Doig sandstones represent a number of lowstand sandstones, each underlain by a regressive surface of marine erosion. When placed in a stratigraphic context, they appear to define a series of lowstand shoreface sandstones within a larger progradational composite sequence. This, however, does not necessitate a eustatic origin.

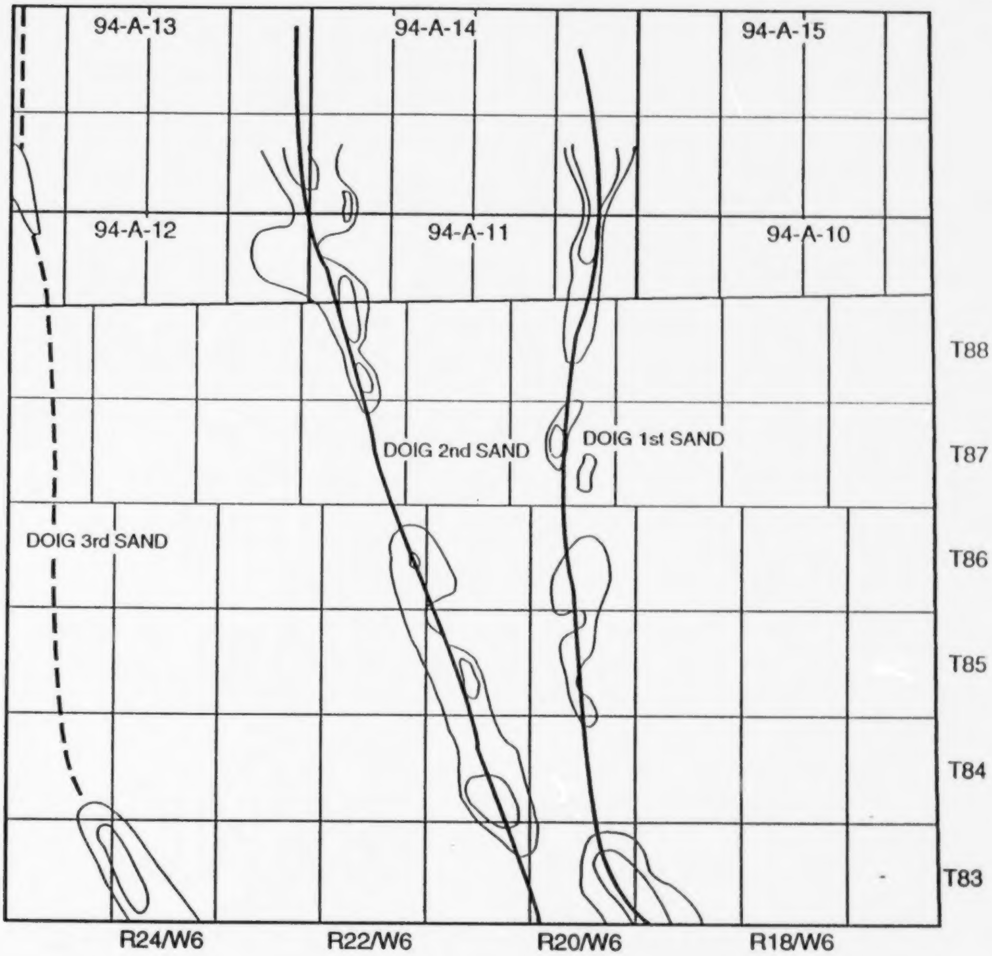
The development of a regressive surface of marine erosion is a predictive response to a fall in relative sea level. With falling sea level there is a net loss of accomodation space; as a result, the rate of sediment supply must always exceed the rate at which accomodation space is created. The shoreline response is an abrupt basinward shift in position termed a 'forced' regression (Plint, 1991; Posamentier *et al.*, 1992a). The base of the forced regression shoreface is a sharp erosional surface reflecting the impact of fairweather wave base scouring the shelf in front of the prograding shoreface (Ainsworth and Crowley, 1994). This can be contrasted with progradational events associated with a stillstand or slow rise in sea level which are characterized by gradational coarsening upwards profiles in a conformable succession (Plint, 1988; Nummendal *et al.*, 1993).

Although 3rd order sea level fluctuations have been recognized globally in the Anisian and Ladinian (Haq *et al.*, 1988; Embry, 1988), the validity of this curve and the relative importance of tectonics in modifying global sea level signatures in the Triassic has been questioned, as has the actual number and correlatability of 3rd order sequences developed during this period (eg. Embry, 1988; van Veen *et al.*, 1992; de Zanche *et al.*, 1993; Yose, 1994). Haq *et al.* (1988) recognize two 3rd order sequences in the Middle Triassic, approximately coincident with the Anisian and Ladinan stages. However, de Zanche *et al.* (1993) document four 3rd order Anisian sequences and three Ladinian 3rd order sequences in one of the Haq *et al.* (1988) type areas, and Rasmussen *et al.* (1992) recognize five Anisian depositional sequences in the Barents Sea. At least two higher order sequences can be recognized within the upper Anisian in the study area.

The development of a series of lowstand erosional surfaces within a relatively narrow chronostratigraphic framework in the Middle Triassic in northeastern British Columbia can best be explained as a series of tectonically driven high-frequency sequence boundaries (*ie:* a non-eustatic fall in relative sea level). The most probable causative mechanism is reactivation of basement structures and the Dawson Creek Graben Complex along the north flank of the Peace River Arch. Recent seismic stratigraphic reconstructions support the interpretation of Anisian and Ladinian reactivation of basement faults in the area (Qi, 1995).

### *Sand Trends and Exploration Strategies*

The Doig Sand in northeastern British Columbia is preserved as a series of narrow, elongate sandstones deposited in a series of lowstand shorefaces associated with abrupt sea level falls. Two lowstand shorefaces have been defined on the basis of sedimentologic characteristics (core control) and stratigraphic correlation (wireline log control) in the vicinity of producing fields, and their trends can be extrapolated for several tens of kilometres in a strike direction. At least one additional sandstone, the 3rd Doig Sand, can be inferred based on a limited number of penetrations (Figure 7-16), but has not been cored. These sandstones are all deposited as shore parallel bodies, and become progressively younger in a basinward direction as part of a 3rd order composite sequence.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94-A-14
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94-A-11
94-A-10
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T87
T86
T85
T84
T83
DOIG 2nd SAND
DOIG 1st SAND
DOIG 3rd SAND
R24/W6
R22/W6
R20/W6
R18/W6

Figure 7-16. Regional Doig sand trends. The 1st and 2nd Doig sand trends are summarized from figures 7-11 and 7-15 respectively. The 3rd Doig sand trend is largely largely interpretive, with 3 and 10 m contours superimposed to show limited data control points. All sands unconstrained along strike.

Sand preservation is discontinuous along the sandstone trends, but sand accumulation appears to be restricted to these trends. No significant Doig sandstones are present in the area basinward of Buick Creek that do not fall along one of these shoreface trends. These shoreface trends therefore provide a powerful exploration model for future development of the Lower Halfway/Doig interval.

The most significant exploration implication of this study is the possibility of the discovery of additional sandstone trends. The body of evidence for tectonic activity in the Western Canada Sedimentary Basin through Lower and Middle Triassic time is significant (eg. Cant, 1984; 1986; Wittenberg, 1992; Caplan, 1993; Qi, 1995; Moslow *et al.*, 1995; CHAPTER 6). There is no reason to believe that all the tectonically induced fluctuations in sea level during the Anisian and Ladinian stages have been identified, and at least as many as five or six higher order sequences have been postulated for this period (Rasmussen *et al.*, 1992; de Zanche *et al.*, 1993).

Detailed sedimentologic analysis of available core combined with revised stratigraphic correlations may reveal evidence of additional lowstand shoreface trends. The Doig sandstones at Rigel and Wildmint (immediately east of the study area) both exhibit sharp based sandstones erosively overlying finely laminated siltstones and shales with apparent offshore/shelf affinity (eg. Talisman *et al.* Rigel 9-19). The trend defined by these two fields passes through the Pee Jay field where limited data suggests an additional Doig sandstone is present (Caplan, 1993).

The anomalously thick Doig sandstone bodies in the Sinclair field area of west central Alberta have been interpreted as shoreface-sourced sediment gravity flow deposits trapped in a series of growth faults along the shelf margin (Wittenberg, 1992; Wittenberg and Moslow, 1992). This model suffers from a lack of direct evidence for the identification of the shelf-slope break, and absence of a predictive mechanism for initiation of growth faulting. Rapid sediment loading associated with an abrupt basinward shift in depositional environments (lowstand progradation) may be adequate to initiate growth faulting in the area, irrespective of the location of the shelf-slope break.

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# CHAPTER 8.

# A COMPARISON OF BYPASS GEOMETRIES IN THE FRASER RIVER DELTA FORESLOPE AND THE MIDDLE TRIASSIC DOIG FORMATION: IMPLICATIONS FOR THE RECOGNITION AND INTERPRETATION OF FORCED REGRESSION SHOREFACES.

## Introduction

The sequence stratigraphic significance of sharp-based linear sand bodies deposited within "deeper-water" facies assemblages has recently received significant attention. These sandstones are typically thin, narrow bodies oriented subparallel to the paleoshoreline, and exhibit sedimentary characteristics consistent with markedly higher-energy depositional conditions and shallow-water accumulation. The abrupt nature of the basal contact has been used to infer a rapid basinward dispacement of the shoreline. These characteristics are consistent with a relative fall in sea level and attendant decrease in available accomodation space, and have given rise to the forced regression model of Plint (1988), Posamentier *et al.* (1992a), Ainsworth and Crowley (1994), and others. The documentation of a *Glossifungites*-demarcated erosional surface coincident with the basal sand contact of some of these sand bodies (eg. MacEachern *et al.*, 1992; Walker and Bergman, 1993; MacEachern, 1994), and the rejuvenation of fluvial drainage systems reflected by the dramatic grain size increase across the discontinuity provide support for the interpretation of these surfaces as sequence boundaries associated with submarine surfaces of erosion, and the placement of these sandstones within the Lowstand Systems Tract.

This model provides a powerful tool for stratigraphic interpretation and prediction. Unfortunately, the most important piece of evidence to support interpretations of this model - *the erosional nature of the discontinuity at the base of the shoreface sands* - is often the least well preserved and/or documented. Not all sharp based shoreface sandstones represent forced regressive shorelines (eg. Saunders *et al.*, 1994). Great care must be taken to determine that the basal sandstone contact represents a significant erosional discontinuity, marked by rapid progradation and formed in response to decreasing accomodation space, as opposed to reflecting local shelf physiography and hydrodynamic conditions of the local storm regime.

Two examples of sediment bypassing and deposition during an abrupt fall of relative sea level on the continental shelf were examined to document the variability in associated siliciclastic facies. The Middle Triassic Doig Formation in northeastern British Columbia, and the modern Fraser River delta foreslope offshore Vancouver, British Columbia, were both deposited under an abrupt fall in relative sea level during a period of global eustatic sea level rise. Each case represents a sharp-based sand body of limited dip dimensions deposited as a component of a high-frequency sequence. Specifically, the Doig represents an archetypal forced regression shoreface deposited as part of the Lowstand Systems Tract, while the Fraser River delta foreslope represents sediment accumulation within the Transgressive or early Highstand Systems Tract.

In essence, the Doig forced regression model accounts for sand bypassing *by bringing the shoreface to "deep-water"*, while bypassing in the Fraser River delta foreslope is via discrete channels and results in the *physical (channelized) transport of sediment from the shoreface across the foreslope, to "deep-water"*. Ultimately, the goal of this research is to document the characteristic facies distribution in marine sandstones associated with sediment bypassing, and to determine if criteria are available to distinguish between forced-regression surfaces and other sharp-based linear sandstone bodies.

## Doig Formation Sedimentology and Stratigraphy

### *Geologic Framework*

There is no documented point source for the Doig sandstones. The climate is considered to have been abnormaly hot and arid during this period (Campbell and Horne, 1986; Parrish, 1993), and deposition occurred in a subtropical environment at a paleolatitude of approximately 30° North (Habicht, 1979). The generally arid climatic conditions during

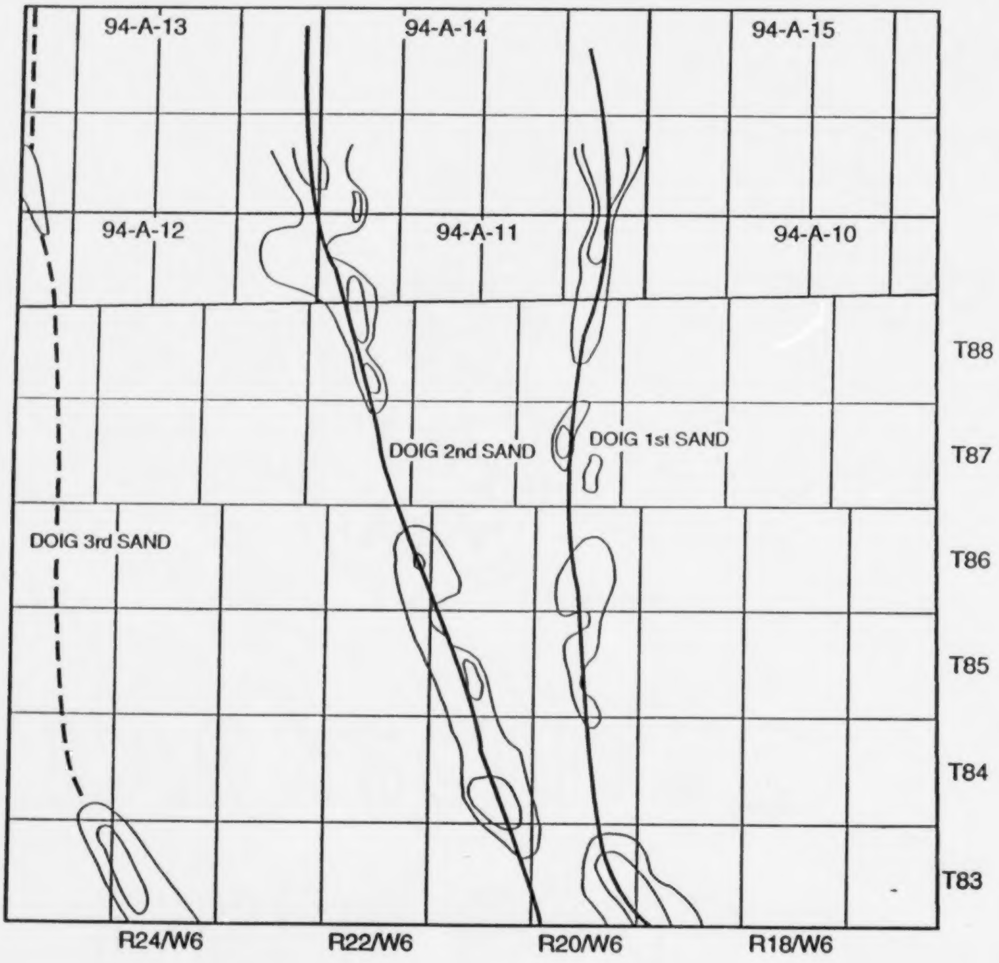
Triassic time are incompatible with significant precipitation and development of fluvial systems in the hinterland.

Middle Triassic strata of northeastern British Columbia have been interpretted to represent a progradational succession of marine to shallow marine clastic sediments deposited on the western flank of the North American craton (Gibson and Barclay, 1989; Edwards et al., 1994). Although 3rd order eustatic sea level fluctuations have been recognized globally in the Anisian and Ladinian (Haq *et al.*, 1988; Embry, 1988), the validity of this curve and the relative importance of tectonics in modifying global sea level signatures in the Triassic has been questioned (Embry, 1988; van Veen *et al.*, 1992; de Zanche *et al.*, 1993; Yose, 1994). The Doig Formation appears to reflect intrabasinal controls (autocyclic processes) dominated by an abrupt fall in relative sea level (base level drop) superimposed on a larger-scale sea level rise.

### *Bypass Sand Geometry*

The following discussion is summarized from observations based on four different producing Doig fields in the Fort St. John area of northeastern British Columbia; specifics have been presented elsewhere (Evoy and Moslow, 1995; Evoy and Moslow, *in press*, CHAPTER 7). Doig sandstones are preserved as a series of long, linear sands oriented subparallel to the paleoshoreline (Figure 8-1). They form narrow reservoirs, asymmetrically distributed about their axes of maximum sand accumulation. There is no direct evidence of the active bypass zone preserved in the Doig sands. The sandstones define regionally persistent, stratigraphically distinct trends, but individual sandstone bodies exhibit irregular thickness along strike.

The two major Doig sandstone trends are refered to herein as the 1st Doig Sand and the 2nd Doig Sand. Doig sandstones are typically very fine- to fine-grained, massive to planar tabular cross-bedded, with variably bedded bioclastic intervals locally. These sandstones are interpreted to represent deposition in a lower-middle through upper shoreface environment.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DOIG 3rd SAND
T86
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T83
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Figure 8-1. Regional Doig sand trends. The 1st and 2nd Doig sand trends are summarized from figures 7-11 and 7-15 respectively. The 3rd Doig sand trend is largely interpretive, with 3 and 10 m contours superimposed to show limited data control points. All sands unconstrained along strike. (From Figure 7-16).

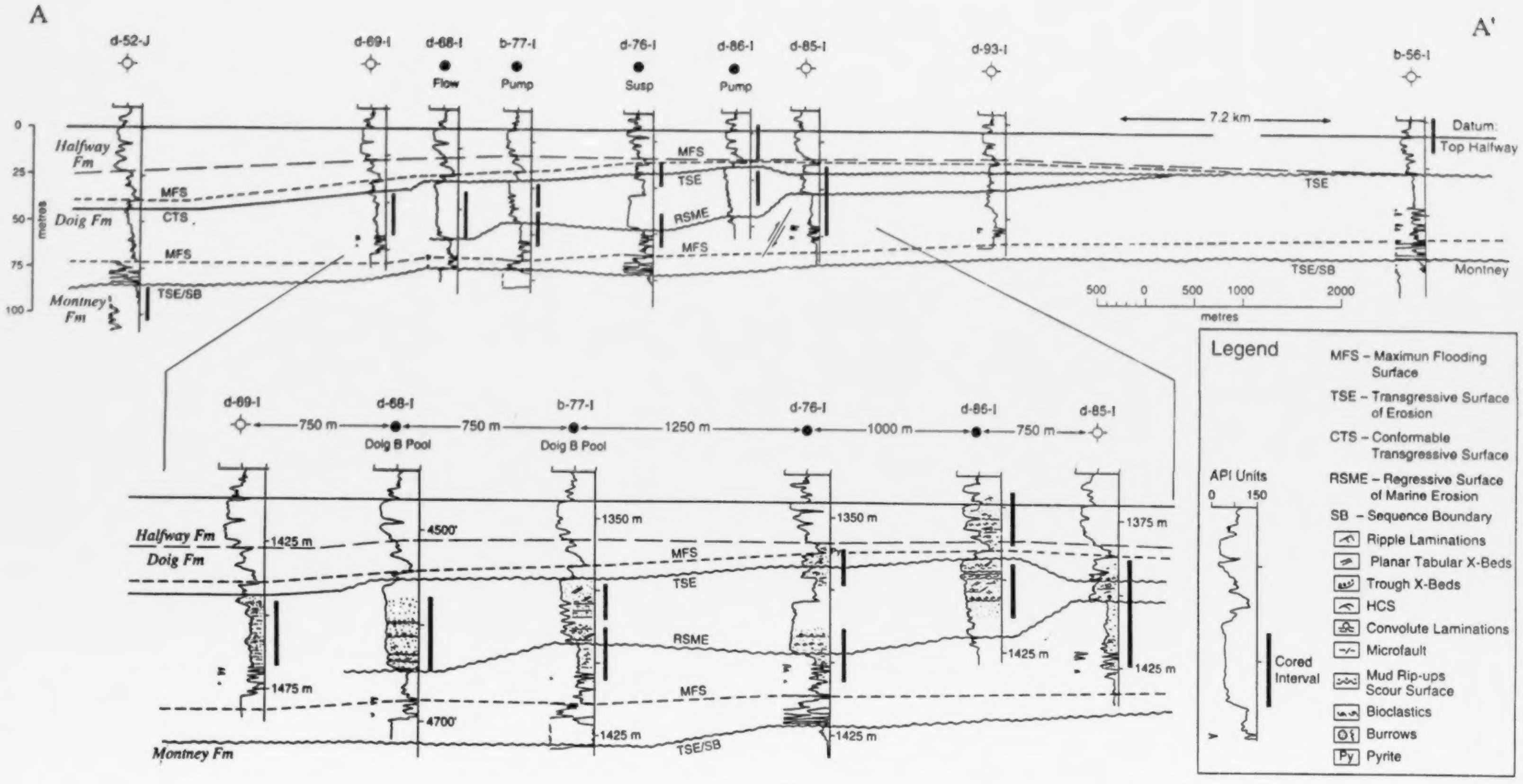
Stratigraphic position suggests that the Doig sandstones are lowstand shorefaces and represent a portion of the Lowstand Systems Tract. The Doig sandstones disconformably overlie offshore/shelf siltstones and shales attributed to the Transgressive Systems Tract and early Highstand Systems Tract. This contact is abrupt, locally truncates markers in the underlying assemblage across a subaqueous ravinement surface, and is locally represented by a *Glossifungites* surface. This erosional surface represents a regressive surface of marine erosion (*cf* Nummendal *et al.*, 1993), and is the subaqueous equivalent of a lowstand surface of erosion.

Because the Doig sandstones were deposited above wave base, there is significant potential for erosion by wave base scour associated with the subsequent transgressive event. The sandstones are rapidly truncated landward by a regional wave ravinement surface, or transgressive surface of erosion, which is overlain by offshore-transition siltstones and sandstones punctuated by numerous storm beds (Figure 8-2). A pronounced transgressive lag deposit is present locally along this bounding discontinuity.

As a result of differences in local basinal geometry and sediment input, although the sandstone trend is continuous along strike, net sand thicknesses need not be (Figure 8-3). Continuity is a function of both preservation and deposition. Evidence for erosion (where present) is primarily up-dip truncation of elements, suggesting that erosion is controlled by basinal physiography and reworking. This is referred to herein as a ***transgression-dominant geometry***, or a shallow-water/ramp geometry.

### *Sequence Stratigraphic Implications*

The development of a subaqueous ravinement surface, or regressive surface of marine erosion, is a predictive response associated with a fall in relative sea level. With falling sea level, there is a net loss of accomodation space. As a result, the rate of sediment supply must always exceed the rate at which accomodation space is created. The shoreline response is an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metres
Halfway Fm
Doig Fm
Montney Fm
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CTS
MFS
TSE/SB
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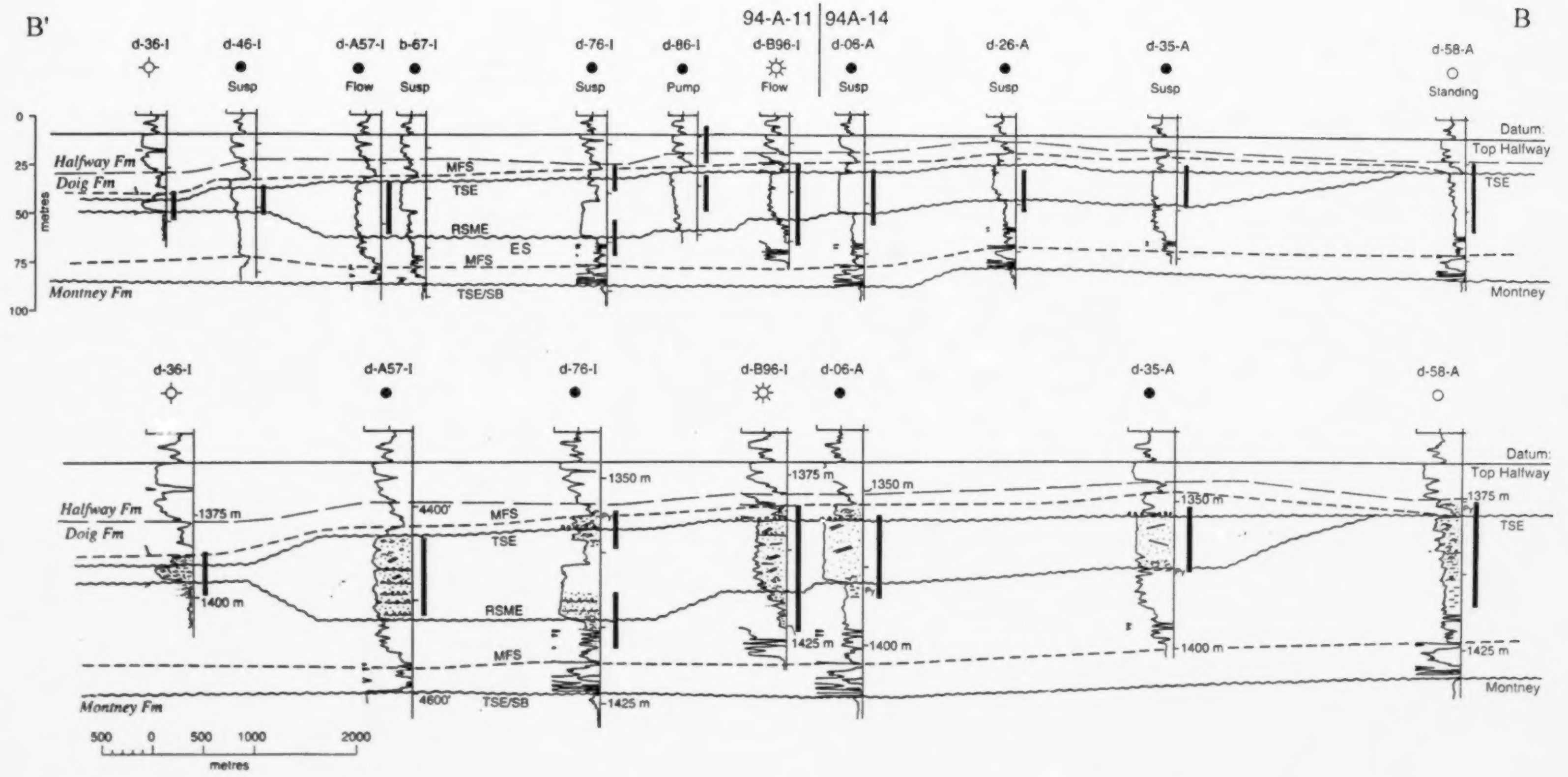
MFS – Maximun Flooding Surface
TSE – Transgressive Surface of Erosion
CTS – Conformable Transgressive Surface
RSME – Regressive Surface of Marine Erosion
SB – Sequence Boundary
Ripple Laminations
Planar Tabular X-Beds
Trough X-Beds
HCS
Convolute Laminations
Microfault
Mud Rip-ups Scour Surface
Bioclastics
Burrows
Py Pyrite

Figure 8-2. Dip-oriented stratigraphic cross-section through the centre of the Buick Creek Field. (From Figure 6-9).
A). Gamma-ray log profile section. The base of the Doig Sand represents a regressive surface of marine erosion (RSME).
B). Gamma-ray and core section showing relationships between facies associations and gross stratigraphic framework in selected wells from Figure 8-2A.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d-26-A
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Montney Fm
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ES
TSE/SB
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1375 m
1400 m
1425 m
4400'
4600'
500
1000
2000

Figure 8-3. Strike-oriented stratigraphic cross-section through the axis of the Buick Creek Field. (From Figure 6-10).

A). Gamma-ray log profile section.

B). Gamma-ray and core section for selected wells from 8-3A. Facies Association 2 is capped by a coarse transgressive lag to the north and an equivalent bioclastic lag to the south. See Figure 8-2 for legend.

abrupt basinward shift in position termed a 'forced' regression (Plint, 1988; 1991; Posamentier *et al.*, 1992a). The base of the forced regression shoreface is a sharp erosional surface reflecting the impact of fairweather wave base scouring the shelf in front of the prograding shoreface (Ainsworth and Crowley, 1994). This can be contrasted with progradation associated with a stillstand or slow rise in sea level which is characterized by gradational coarsening upwards profiles in a conformable succession (Plint, 1988; Nummendal *et al.*, 1993).

The 1st Doig Sand trend and its bounding discontinuities can be traced for a minimum 75 km along strike. The trend does not represent continuous clean sand, but a number of discrete sandstone bodies, all showing the same general orientation, are preserved locally (Figure 8-1). This discontinuous preservation likely reflects the nature of the original sand distribution, modified by subsequent transgressive reworking. Sandstone accumulation is spatially associated with breaks in slope in the underlying regressive surface of marine erosion (Figures 8-2, 8-4), implying an element of tectonic control over sand distribution. This implies that structural controls on sand deposition and preservation must be in part syndepositional. Similar breaks in slope are evident along the Doig/Montney contact (Figure 8-4).

There is a strong degree of parallelism apparent in the orientation of the 1st and 2nd Doig Sands (Figure 8-1). The Doig sandstones represent a number of shoreface sandstones, each underlain by a regressive surface of marine erosion. When placed in a stratigraphic context, they appear to define a series of lowstand shoreface sandstones within a larger progradational composite sequence. This, however, does not necessitate a eustatic origin. Although 3rd order eustatic sea level fluctuations have been recognized globally in the Anisian and Ladinian (Haq *et al.*, 1988; Embry, 1988), the validity of this curve and the relative importance of tectonics in modifying sea level signatures in the Triassic is a topic of much debate (eg. Embry, 1988; van Veen *et al.*, 1992; de Zanche *et al.*, 1993; Yose, 1994).

The development of a series of lowstand erosional surfaces within a relatively narrow

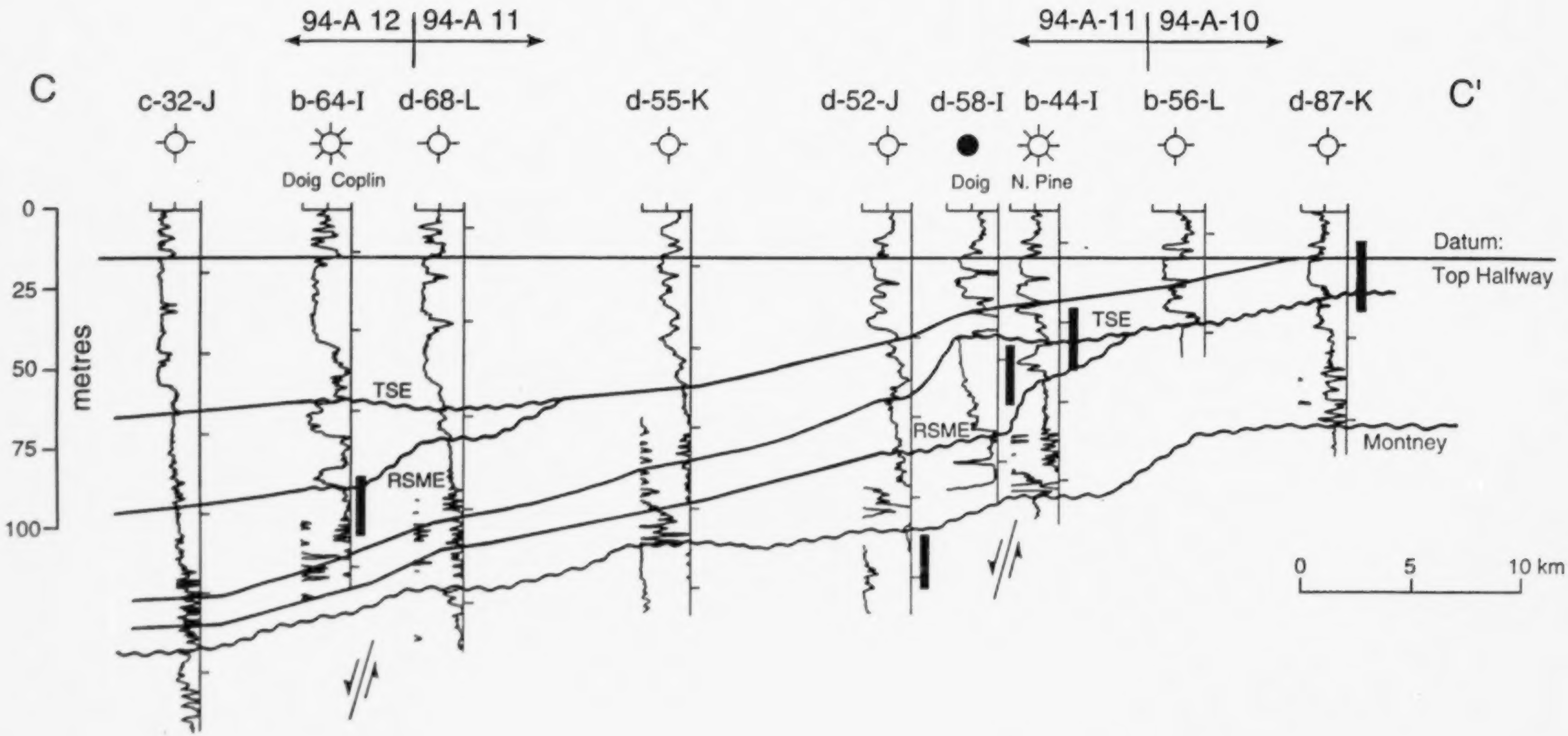
94-A 12
94-A 11
94-A-11
94-A-10
C
C'
c-32-J
b-64-I
d-68-L
d-55-K
d-52-J
d-58-I
b-44-I
b-56-L
d-87-K
Doig Coplin
Doig
N. Pine
0
25
50
75
100
metres
Datum:
Top Halfway
TSE
RSME
TSE
RSME
Montney
0
5
10 km

Figure 8-4. Regional gamma-ray dip section through the Cache Creek and Buick Creek field areas. Solid black bars represent intervals with core control. (From Figure 7-13).

chronostratigraphic framework in the Middle Triassic can best be explained as a series of tectonically driven high-frequency sequence boundaries (*ie:* a non-eustatic fall in relative sea level). The most probable causative mechanisms are reactivation of Paleozoic basement structures and continued subsidence of the Dawson Creek Graben Complex along the north flank of the Peace River Arch. Recent seismic stratigraphic reconstructions support the interpretation of basement fault reactivation during Anisian and Ladinian time as the dominant control (Qi, 1995).

## Fraser River Delta Foreslope

### *Geologic Framework*

The Fraser River delta foreslope is controlled by fluvial sedimentation processes (point source), modified by tidal redistribution. The delta is protected from significant storm-wave influence by Vancouver Island and the limited fetch across the Strait of Georgia, and progrades directly into a deep water environment. The area experiences a temperate climate, receives abundant annual precipitation, and drains a large, high-relief source area. The role of extrabasinal control (allocyclic processes) is significant, and seismic activity may play a role in initiating the remobilization of sediment.

Inception of sedimentation in the Fraser River delta at the beginning of Holocene time was coupled with an isostatically driven fall of local sea level of about 200 m (Clague *et al.*, 1982), followed by 12 to 13 m of transgression during the subsequent 8000 years (Clague *et al.*, 1982; Williams and Roberts, 1989). During this period of relative sea level rise, the delta experienced only local transgression, and underwent continual progradation and vertical accretion. Rates of vertical accretion accelerated dramatically, coincident with the rate of sea level rise, as a function of increasing accomodation space.

The delta foreslope is bisected by two pronounced bathymetric channels. The Sand Heads Sea Valley, off the Main Arm of the Fraser River, is the only active channel on the foreslope; consequently, most studies of sediment transport and failure on the subaqueous delta have concentrated on this area (eg. Kostaschuk *et al.*, 1989; Hart *et al.*, 1992; Kostaschuk *et al.*, 1992; McKenna *et al.*, 1992). Due to the requirements of navigation, the Main Arm has experienced significant cultural modifications, including construction of the Steveston Jetty and continually dredging. The Roberts Bank channel is currently inactive, and predates any appreciable anthropogenic mediation. It therefore more accurately reflects the natural state of sedimentation on the subaqueous delta, and was emphasized in this study.

### *Bypass Sand Geometry*

The Fraser River delta foreslope is an environment of active sand bypassing. Much of the coarsest sediment supplied to the mouth of the delta bypasses the delta plain and upper foreslope to be introduced directly to the lower foreslope and basin floor via turbidity currents within a number of subaqueous distributary channels. These channels are believed to be initiated and maintained by sediment gravity flow processes related to periodic liquifaction and failure at the head of the foreslope. Deposition occurs where these channels debouche onto the basin floor as a series of sand-rich depositional lobes (Moslow *et al.*, 1991; 1993; Evoy *et al.*, 1994).

Development of multiple channels through time on the delta foreslope has resulted in a high degree of along-slope facies variability and sand deposition in water depths exceeding 200 metres. Through time the location of the depositional lobes changes in conjunction with upslope channel migration and avulsion (Figure 8-5). The resultant sand body geometry is perpendicular to sediment transport direction. As a number of depositional lobes coalesce, they generate elongate, strike-parallel, shaped sands developed at the base of the delta slope in water depths of 200 to 250 metres. Without an abundance of available and preserved plant material, there would be no evidence of close proximity to the paleoshoreline.

Down slope sand termination is abrupt; up slope the sands thin more gradually into

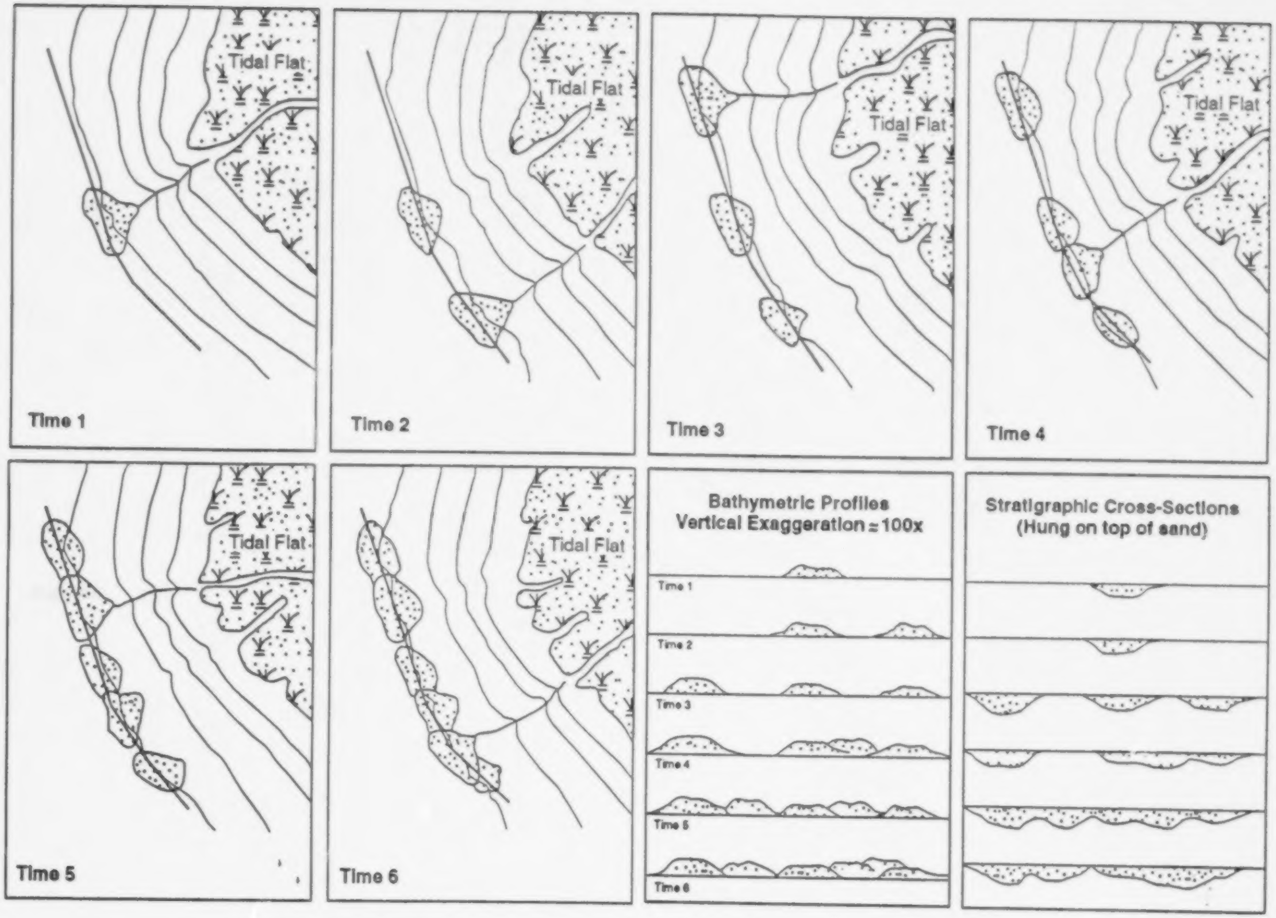
Time 1
Time 2
Time 3
Time 4
Time 5
Time 6
Tidal Flat
Bathymetric Profiles
Vertical Exaggeration ≈ 100x
Stratigraphic Cross-Sections
(Hung on top of sand)
Time 1
Time 2
Time 3
Time 4
Time 5
Time 6

Figure 8-5. Time sequence diagram showing conceptual model for development of linear sand bodies at the base of the subaqueous Fraser River delta foreslope. (From Figure 5-18).

the bypass zone. This results in a wedge-shaped sand body geometry in dip orientation (Figure 8-6). Although the entire channel/fan system migrates, the channel is an environment of bypassing, and little sand accumulates within the channels. These *'bypass chutes'* are geologically short lived, and may not exhibit any significant evidence for either erosion or downcutting. Reduction of the stratigraphic section may only become significant after a single channel captures all available discharge.

It is worth noting that as a result of periodic avulsion, although the sand trend is continuous along strike, sand thickness need not be. While the depositional environments are different, the predictive geometry for the Fraser River delta foreslope sands is remarkably similar to that seen in the Doig sandstone at Buick Creek (Figure 8-3 *vs* Figure 8-5). Deposition and bypassing on the foreslope occur below wave base; consequently there is no evidence for transgressive erosion, *per se*. The depositional lobes themselves are not related to wave induced shoreface failure, but are a function of fluvial discharge (sediment supply) and channel switching. Evidence for erosion (where present) is limited to the truncation of strike parallel elements along the walls of the Sand Heads Sea Valley.

### *Implications of Channel Type for Deposition of Deep Water Sands*

The Roberts Bank Channel is currently inactive and is believed to predate any appreciable cultural mediation. The channel is constructional in nature with well develped depositional levees, and lacks any evidence of erosional downcutting or its fluvial origin. Much of the coarsest sediment supplied to the head of the channel bypasses the delta plain and upper foreslope to be introduced directly to the lower foreslope and basin floor as a small well-developed depositional lobes. The resultant sand body geometry produces a wedge which both thickens and coarsens down slope (Figure 8-6). Up slope, the channel sands thin and pinch out into the finer-grained sediments (silts and clay) of the middle foreslope bypass zone.

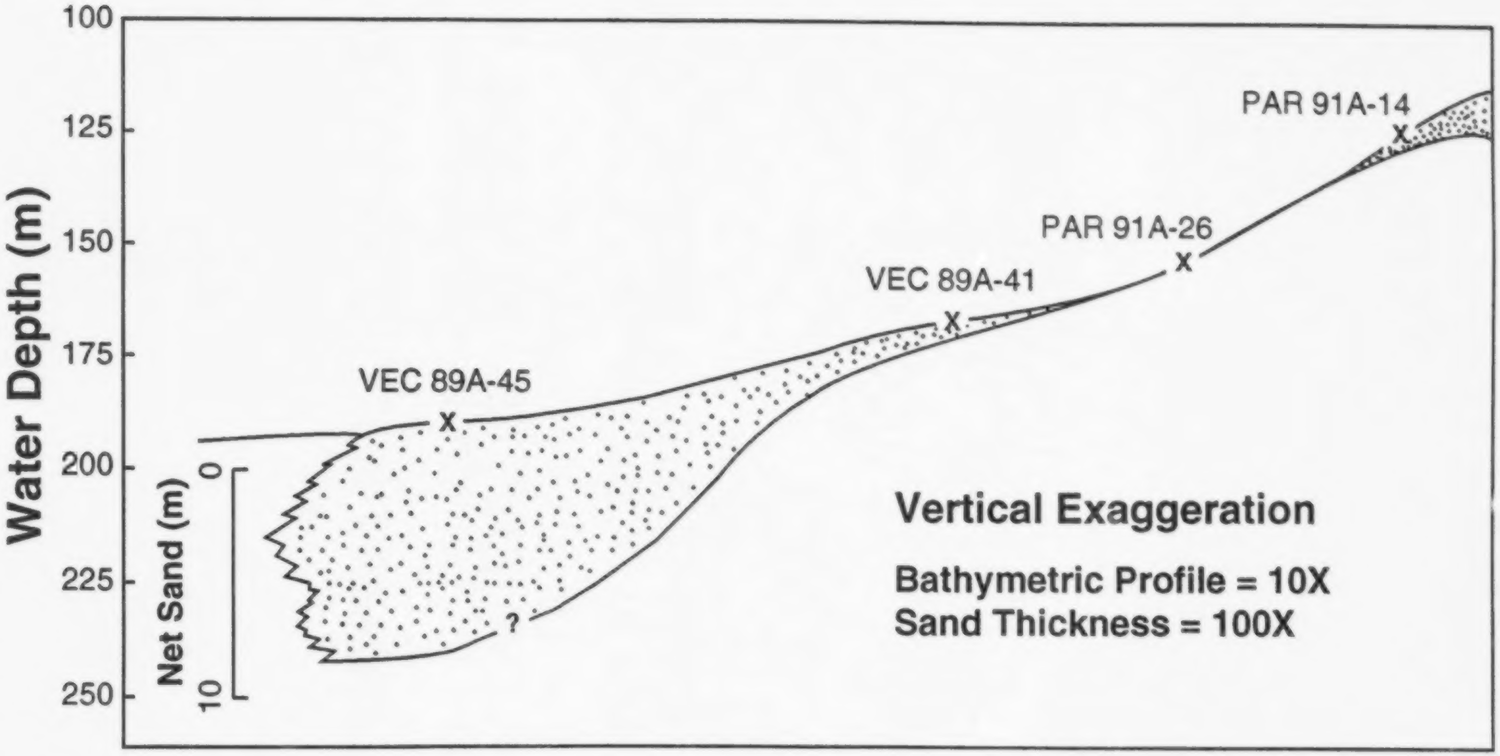
Water Depth (m)
100
125
150
175
200
225
250
Net Sand (m)
0
10
VEC 89A-45
VEC 89A-41
PAR 91A-26
PAR 91A-14
?
Vertical Exaggeration
Bathymetric Profile = 10X
Sand Thickness = 100X

Figure 8-6. Sand bypassing model and wedge geometry for the Fraser River delta foreslope. (From Figure 5-17).

The sand depocentre and maximum sand thickness occurs at the base of the foreslope where turbidity currents become unconfined and deposit their bedload. In conjunction with upslope channel migration, the depocentre can be expected to migrate (Figure 8-5). Through time, this will produce a series of linear sand bodies oriented subparallel to bathymetry. Amalgamation of these sands should ultimately result in a single elongate, strike-parallel sand wedge resting on deep-water muds. In the subaqueous Fraser River delta, this process has been arrested by construction of the Steveston Jetty and cultural stabilization of the distributary channels.

The position and nature of the Sand Heads Sea Valley is strongly controlled by cultural modification. The main channel in the middle and lower delta foreslope is several hundred metres wide, up to 18 m deep, and exhibits steep, erosional channel walls capped by crude depositional levees. Unlike the Roberts Bank Channel, channel migration in the Sand Heads Sea Valley is restricted within the confines of the main valley. Sand deposition within the channel should be similarily controlled by the valley geometry. Over time, this should be anticipated to result in an erosional valley subaqueously incised into deep water muds, and subsequently filled with coarser sediment. Although superficially similar to an incised valley, both incision and deposition occur during the early phase of a single transgressive event, and facies on either side of the erosional surface are genetically related.

Reduction of the stratigraphic section may only become spatially/volumetrically significant after a single channel captures all available discharge (*ie. the fluvial system becomes "fixed"*). This is an important consideration. Experimental modelling of the response of fluvial systems to sea level fall shows that a significant time gap exists between fall of sea level below the shelf slope break and the development of cross-shelf bypass via incised valleys (Koss *et al.*, 1994). Further, rapid sea level fall inhibits development of incised valleys (Wood *et al.*, 1993), as does shelf gradient (Wood *et al.*, 1994).

The implications of a fixed valley system for the development of the depositional lobe at the base of the valley is problematic. The Sand Heads Sea Valley depositional lobe is less well defined than the Roberts Bank depositional lobe, and is subject to sediment failure and remobilization. This results in a greater down dip displacement of sediment than occurs in the Roberts Bank Channel. Through time, a large submarine fan elongate in a dip direction should be anticipated, as opposed to the strike parallel wedge geometry expected from ephemeral channels.

## Conclusions

The significance of sediment bypassing in the delivery of sand to "deep-water" environments has been long recognized. The resultant sand bodies provide excellent hydrocarbon targets as they are frequently encased in fine-grained marine clastics which may provide both potential source rock and seals. These sands may also represent the sole remaining evidence for significant fluctuations in relative sea level.

A number of models exist for the development of "sharp-based" sands associated with a rapid fall in relative sea level. The Doig sandstones in northeastern British Columbia are preserved as a series of narrow, elongate sandstone bodies deposited as lowstand shorefaces associated with abrupt sea level falls. Two lowstand shoreface sandstones (the 1st and 2nd Doig Sands) have been defined on the basis of sedimentologic characteristics and stratigraphic correlation in the vicinity of producing fields; their trends can be extrapolated for several tens of kilometres in a strike direction. At least one additional sandstone, the 3rd Doig Sand, can be inferred based on a limited number of penetrations, but has not been cored. These sands are all deposited as shore parallel bodies, and become progressively younger in a basinward direction as part of a 3rd order composite sequence. Sand preservation is discontinuous along the sandstone trends, but appears to be restricted to these trends. No significant Doig sandstones are present in the area basinward of Buick Creek that do not fall along one of these shoreface trends.

The Doig Sands represent archetypal forced regression sandstones deposited as a series of high-frequency lowstand shorefaces imprinted on a lower frequency sequence set or composite sequence. The processes responsible for the deposition of lowstand sands are a function of decreasing accomodation space. Consequently, they are independant of the *mechanism* of sea level fall (*ie*. eustatic *vs*. tectonic). Similarly, sediment bypassing is strongly influenced by the sense and rate of sea level displacement, magnitude of sea level change, and basin physiography.

The Fraser River delta foreslope is crossed by two bathymetric channels initiated and maintained by sediment gravity flow processes related to periodic liquifaction and failure at the head of the foreslope. Much of the coarsest sediment supplied to the mouth of the delta bypasses the delta plain and upper foreslope, and is introduced directly to the lower foreslope and basin floor where these channels debouche to produce a series of sand-rich depositional lobes. The development of a number of similar channels on the delta foreslope through time has resulted in a high degree of along-strike lateral facies variability. Upslope migration and abandonment of ephemeral channels results in the deposition of a strike-parallel sand wedge (slope apron) formed by the coalesence of a number of small submarine fans at the base of the foreslope. Deposition from a fixed channel (point source) should be anticipated to result in the construction of an elongate submarine fan normal to depositional strike and bathymetry.

The Fraser River delta foreslope represents a process analogue for the development of some lowstand sands. Forward modelling of the Roberts Bank depositional lobe results in the generation of a linear sand body which exhibits several pronounced similarities with classic lowstand forced regression shorefaces. In the absence of diagnostic sedimentologic criteria to determine the depositional environment present in the "lowstand sand", and evidence of a significant erosional discontinuity across the basal contact, this sand could be readily misinterpreted in the stratigraphic record as a forced regression, or other representation of a dramatic and abrupt sea level fall. Long, linear, shore-parallel sand bodies that are both sharp-based and narrow can develop below wave base. Their geometry may not simply reflect fairweather wavebase scour and subsequent transgressive reworking *aka* the forced regression model; lack of strike continuity may reflect either initial depositional conditions, or subsequent transgressive reworking.

Possibly the most important implications of this research are cautionary. Sequence stratigraphy is a methodologic approach to the study of rocks relationships within a chronostratigraphic framework of genetically related strata (Van Wagoner *et al.*, 1988). As a result of the early emphasis on the recognition and documentation of of global scale sea level fluctuations (eg. Payton, 1977 and papers therein), eustatic sea level fluctuations are over-emphasized in many sequence stratigraphic reconstructions. This trend has been exaggerated by the need to assume a periodic, curvilinear sea level curve for numerical modelling (eg. Jervey, 1988; Posamentier et al., 1988; Mitchum and Van Wagoner, 1991). Sequence stratigraphic concepts, however, are both time- and scale-independant (Posamentier *et al.*, 1992b; Koss *et al.*, 1994). The processes associated with sea level change are independant of the mechanics of sea level change.

The current reinterpretation of many offshore sands and shelf ridges as lowstand shorefaces is often a significant advance in our study of basin architectures. However, the assertion that all similar shelf sand bodies must therefore also represent lowstand shorefaces (Walker and Bergman, 1993, p.851) is a gross generalization and dangerous simplification. Even though forced regressions can generate sharp-based sands, *sharp-based sands do not equal forced regressions*. An abrupt contact and sudden change in lithology simply represents a sudden change in depositional energy; of itself, it does not reveal anything about what caused that change. Such interpretations can only be made based on detailed sedimentologic observations and careful documentation of lateral and vertical facies relationships.

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# CHAPTER 9.
# SUMMARY AND CONCLUSIONS

Two examples of sediment bypassing and deposition during an abrupt fall of relative sea level on the continental shelf were examined to document the variability in associated siliciclastic facies. The modern Fraser River delta foreslope offshore Vancouver, British Columbia, and the Middle Triassic Doig Formation in northeastern British Columbia, were both deposited under an abrupt fall in relative sea level during a period of global eustatic sea level rise. Each case represents a sharp-based, linear sand body deposited as a component of a high-frequency sequence. The ultimate goal of this research is to use the lateral and vertical facies variability and geometry of lowstand sand bodies to document the characteristic facies relationships in marine sandstones associated with sediment bypassing during a fall in relative sea level, and to determine if criteria are available to distinguish between forced regression surfaces and other sharp-based linear sand bodies.

## Fraser River Delta Foreslope

The first half of this dissertation (Chapter 2 through Chapter 5) represents a study of sedimentation styles on the Fraser River delta foreslope, and documents the significance and processes of sediment bypassing in the delivery of sand to the prodelta and basinal environment. A conceptual model is developed to explain the development of bathymetrically constrained linear sand bodies in water depths in excess of 200 m at the base of the delta foreslope.

The Fraser River delta foreslope is cut by two pronounced bathymetric channels, initiated and maintained by sediment gravity flow processes related to periodic liquifaction and failure at the head of the foreslope. Each channel exhibits significantly different characteristics: 1) the Roberts Bank Channel is currently inactive, represents an ephemeral feature on the delta foreslope, and is a constructional feature with well developed depositional levees, and 2) the Sand Heads Sea Valley has been culturally fixed, is an erosional feature, and exhibits steep valley walls marked by truncation of parallel reflectors and erosional undercutting.

In Chapter 2, sediment accumulation rates and patterns (determined from Cs-137 profiles), and allochthonous micropaleontological assemblage distributions, are used to document the reintroduction of older sediment from upslope via slumping and sediment-gravity flow processes. Such processes of remobilization are shown to account for the bulk of sedimentation over much of the subaqueous delta slope.

Grain size distribution patterns and textural parameters are used in Chapter 3 to further document the significance of sand bypassing on the delta foreslope, and to constrain the type of sediment-gravity flows responsible for sand bypassing. Much of the coarsest sediment supplied to the mouth of the delta bypasses the delta plain and upper foreslope and is introduced directly to the lower foreslope and basin floor where channels debouche to produce a series of sand-rich depositional lobes. Subsamples of piston cores collected from depositional lobes at the base of the foreslope rarely contain sufficient clay components to have exhibited cohesive strength during transport; turbidity currents appear to be the dominant mechanism for the delivery of sand to depositional lobes at the base of the foreslope.

The variability of sedimentary facies on the delta foreslope are documented in Chapter 4 using sedimentologic descriptions of piston cores, and high frequency (3.5 kHz) seismic profiles. Facies distribution patterns show that sand-sized sediment is a significant component of the lower foreslope, and suggests that the delta foreslope has been dissected by a number of historic channels, in addition to those with current bathymetric expressions. The incision of multiple channels through time on the delta foreslope has resulted in a high degree of along-slope lateral facies variability. Sedimentologic characteristics are compatible with sediment transport as periodic turbidity currents. The bulk of the sediment deposition occurs where these channels debouche at the base of the foreslope, and the channelized turbidity currents become unconfined.

The geometries and sedimentary characteristics of the two main bathymetric channels on the delta foreslope - one in its natural state, and one which has been culturally modified - are compared and contrasted in Chapter 5. By integrating the data from previous chapters with additional piston core descriptions and high frequency seismic profiles, a conceptual model is developed predicting the generation of linear sand bodies at the base of the delta foreslope. As a result of upslope channel migration and avulsion, a strike parallel sand wedge (slope apron) will form through the coalesence of small depositional lobes at the base of the foreslope. This process has been arrested by construction of the Steveston Jetty and dredging of the main navigation channel.

## Doig Formation

The second half of this dissertation (Chapters 6 and 7) is a study of the sedimentary characteristics and geometry of a number of reservoirs producing from the Doig Formation in northeastern British Columbia. The methodology for each field study is to complete a sedimentologic analysis of all available cores using a process sedimentologic approach to infer depositional processes, document facies associations, and determine depositional environments. These data are then integrated with wireline logs to construct a depositional model within a sequence stratigraphic framework.

The Doig Sand in northeastern British Columbia is preserved as a series of narrow, elongate sandstones deposited as a series of lowstand shorefaces associated with abrupt sea level falls. Two lowstand shorefaces have been identified on the basis of their sedimentologic characteristics (core control) and stratigraphic correlation (wireline log control) in the vicinity of producing fields. The trend of these shorefaces can be extrapolated for several tens of kilometres in a strike direction; sand preservation is discontinuous along the sand trends, but appears to be restricted to these trends. At least one additional sand body can be inferred based on a limited number of penetrations, but has not been cored. These sandstones are all deposited as shore-parallel bodies, and become progressively younger in a basinward direction as part of a 3rd order composite sequence.

The Buick Creek Field represents the largest recognized Doig reservoir in the study area, and largest subsurface database available. Due to the abundance of available core, in Chapter 6 depositional processes and facies associations for the Doig interval were determined directly, based on observed physical characteristics. Three facies associations were recognized: 1) offshore/shelf, 2) shoreface, and 3) offshore transition. All production is from Facies Association 2, a fine-grained, massive sandstone which erosionally overlies Facies Association 1 and is abruptly overlain by Facies Association 3 across a pronounced transgressive surface of erosion.

The results of the Buick Creek study were expanded regionally in Chapter 7 to test the applicability of the forced regression shoreface model to other Doig reservoirs in northeastern British Columbia. Doig sandstones from four different fields show similar patterns in distribution of facies and facies associations. The sandstones are typically very fine- to fine-grained, and are massive to planar tabular cross-bedded. The basal contact between Facies Association 2 sandstones and underlying lithologies is disconformable, and can locally be seen to truncate markers in the underlying lithologies, or is represented by a *Glossifungites* surface. This erosional surface represents a regressive surface of marine erosion (equivalent of a lowstand surface of erosion). At least two separate sandstones can be recognized. The 1st Doig Sand trend and its bounding discontinuities can be traced for a minimum 75 km along strike; the 2nd Doig Sand is recognized 10 to 20 km basinward of, and stratigraphically overlies, the 1st Doig Sand. This development of a series of lowstand erosional surfaces within a relatively narrow chronostratigraphic framework can best be explained as a series of tectonically driven high-frequency sequence boundaries.

### Bypass Models

The bypass sand geometries of the Fraser River delta foreslope and the Doig Formation are compared in Chapter 8. Sand deposition on the Fraser River delta foreslope is in the form of small depositional lobes or submarine fans deposited where subaqueous distributary channels debouche at the base of the foreslope. Through time, upslope channel migration and abandonment are expected to result in a linear sand body trend at the base of the foreslope formed by the coalesence of a number of small depositional lobes. Delivery of sand is controlled by both intrabasinal and extrabasinal factors dominated by a pronounced fluvial point source, and an isostatically-induced, abrupt fall in relative sea level.

The Fraser River delta foreslope represents sediment accumulation within the Transgressive Systems Tract or early Highstand Systems Tract. Sand bypassing is via discrete channels on the foreslope, and results in the *physical (channelized) transport of sediment from the shoreface, across the foreslope, to "deep-water".*

The Doig Sand is preserved as a series of long linear sandtone bodies exhibiting all the characteristics of a forced regression lowstand shoreface. Fine- to medium-grained sandstones with lower to upper shoreface affinity directly overlie offshore siltstones and shales across an erosional discontinuity locally demarcated by the development and preservation of a *Glossifungites* surface, and truncation of underlying lithologies. Controls over sediment delivery and preservation are intrabasinal, with sediment delivered from a linear source. Structural control on sand body geometries is well established.

The Doig represents an archetypal forced regression shoreface deposited as part of a high-frequency Lowstand Systems Tract. The development of lowstand shorefaces is dominated by an abrupt fall in relative sea level, and represents a necessary response to the attendant decrease in available accomodation space. In essence, the forced regression model accounts for sand bypassing by *bringing the shoreface to "deep-water".*

## Conclusions

The significance of sediment bypassing in the delivery of sand to "deep-water" environments has been long recognized. The resultant sand bodies provide excellent hydrocarbon targets as they are frequently encased in fine-grained marine clastics which may provide both potential source rock and seals. These sands may also represent the sole remaining evidence for significant fluctuations in relative sea level.

Possibly the most significant implications of this research are two cautionary observations. First, *sharp-based sands do not equal forced regressions*. Such geometries can result from either autocyclic or allocyclic mechanisms. Second, *eustatic sea level fluctuations are over-emphasized* in many sequence stratigraphic reconstructions. Conversely, the role of local tectonics is frequently underemphasized in its significance.

A number of models exist for the development of "sharp-based" sands associated with a rapid fall in relative sea level. The Doig Sands represent a number of archetypal forced regression sand bodies which were deposited as a series of high-frequency lowstand shorefaces imprinted on a lower frequency sequence set or composite sequence. The processes responsible for the deposition of lowstand sands are a function of decreasing accomodation space. Consequently, they are independant of the *mechanism* of sea level fall (*ie*. eustatic *vs*. tectonic). Similarly, sediment bypassing is strongly influenced by the sense and rate of sea level displacement, magnitude of sea level change, and basin physiography

The Fraser River delta foreslope represents a process analogue for the development of some lowstand sands. Forward modelling of the Roberts Bank depositional lobe results in the generation of a linear sand body which exhibits several pronounced similarities with classic lowstand forced regression shorefaces. In the absence of diagnostic sedimentologic criteria to determine the depositional environment present in the "lowstand sand", and evidence of a significant erosional discontinuity across the basal contact, this sand could be readily misinterpreted in the stratigraphic record as a forced regression, or other representation of a dramatic and abrupt sea level fall. Long, linear, shore-parallel sand bodies that are both sharp based and narrow can develop below wave base. Their geometry may not simply reflect fairweather wavebase scour and subsequent transgressive reworking *aka* the forced regression model. Lack of strike continuity may thus reflect initial depositional conditions or subsequent transgressive reworking.

# APPENDIX A: FRASER RIVER DELTA STUDY
## LIST OF CORES

| CORE I.D. | WATER DEPTH | CORE LENGTH | CORE TYPE | LOGGED BY: | GZ Data | FACIES TYPE(S) | | | DEPOSITIONAL SETTING |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Major | Minor | Rare | |
| VEC 83A - 23 | 231 m | 150 cm | GRAVITY | GSC | GSC | 1 | | | Sturgeon Bank - Prodelta |
| 25 | 163 m | 135 cm | GRAVITY | GSC | GSC | 1/2 | | | Sturgeon Bank - Lower Foreslope |
| 26 | 185 m | 151 cm | GRAVITY | GSC | GSC | 2/1 | 3? | 4 | Sturgeon Bank - Lower Foreslope |
| 27 | 183 m | 154 cm | GRAVITY | GSC | GSC | 2/1 | 3? | 4 | Sturgeon Bank - Lower Foreslope |
| VEC 83B - 35 | 202 m | 67 cm | GRAVITY | RWE | GSC | 1/2 | | | Roberts Bank - Lower Foreslope |
| 36 | 152 m | 164 cm | GRAVITY | RWE | GSC | 1/2 | | 4? | Roberts Bank Interchannel - Lower Foreslope |
| 37 | 241 m | 31 cm | GRAVITY | RWE | GSC | 1 | 4 | | Roberts Bank - Lobe Fringe |
| 38 | 240 m | 62 cm | GRAVITY | RWE | GSC | 1/2 | 4 | | Roberts Bank - Lobe Fringe |
| VEC 89A - 1 | 280 m | 580 cm | PISTON | RWE | UofA | 1 | | | Basin Floor |
| 3 | 190 m | 220 cm | PISTON | RWE | UofA | 4 | 1 | | SHSV Flank - Lower Foreslope |
| 6 | | 106 cm | PISTON | RWE | UofA | 1/2 | 4 | | SHSV Levee - Lower Foreslope |
| 7 | | 465 cm | PISTON | RWE | UofA | 2/1 | | 4? | Roberts Bank Interchannel - Lower Foreslope |
| 18 | 170 m | 381 cm | PISTON | RWE | UofA | 1/2, 4 | | | Sturgeon Bank - Lower Foreslope |
| 19 | 136 m | 460 cm | PISTON | RWE | | 2/1 | | | Sturgeon Bank - Middle Foreslope |
| 20 | 93 m | 420 cm | PISTON | RWE | UofA | 1/2 | | 4 | Sturgeon Bank - Upper Foreslope |
| 21 | 50 m | 423 cm | PISTON | RWE | UofA | 2, 1 | | 4 | Sturgeon Bank - Upper Foreslope |
| 22 | 206 m | 510 cm | PISTON | RWE | | 1, 2 | | | Sturgeon Bank - Prodelta |
| 23 | 174 m | 188 cm | PISTON | RWE | UofA | 1/2, 4? | 4 | | Sturgeon Bank - Lower Foreslope |
| 25 | 240 m | 137 cm | PISTON | RWE | UofA | 4 | | | Sand Heads Sea Valley - Lobe |
| 39 | 163 m | 132 cm | PISTON | RWE | UofA | 4, 2 | 1 | | Roberts Bank - Middle Foreslope |
| 40 | 212 m | 486 cm | PISTON | RWE | UofA | 1 | 2 | 5 | Roberts Bank - Lower Foreslope/Prodelta |
| 41 | | 145 cm | PISTON | RWE | UofA | 4 | 2 | 1 | Roberts Bank Channel - Lower Foreslope |
| 42 | 176 m | 62 cm | PISTON | RWE | UofA | 4 | 1 | | Roberts Bank Channel - Lower Foreslope |
| 44 | 182 m | 280 cm | PISTON | RWE | UofA | 4 | 2 | 1 | Roberts Bank Channel - Lower Foreslope |
| 45 | 231 m | 165 cm | PISTON | RWE | UofA | 4 | 2? | 2, 1 | Roberts Bank - Lobe |
| 46 | 46 m | 101 cm | PISTON | RWE | UofA | 4, 3 | 2, 1 | | Roberts Bank - Upper Foreslope |
| PAR 91A - 3 | 76 m | 228 cm | VIBRACORE | GSC | | 4, 1, 2 | | | Roberts Bank - Upper Foreslope |
| 9 | 188 m | 372 cm | PISTON | RWE | | 1, 2 | 4 | | Roberts Bank - Lower Foreslope |
| 10 | 175 m | 212 cm | PISTON | GSC | | 2 | 1 | 4 | Roberts Bank - Lower Foreslope |

| CORE I.D. | WATER DEPTH | CORE LENGTH | CORE TYPE | LOGGED BY: | GZ Data | FACIES TYPE(S) Major | Minor | Rare | DEPOSITIONAL SETTING |
|---|---|---|---|---|---|---|---|---|---|
| PAR 91A - 11 | 143 m | 438 cm | PISTON | RWE | GSC | 2, 1 | 3 | 4? | Roberts Bank Interchannel - Lower/Middle Foreslope |
| 12 | 120 m | 362 cm | PISTON | RWE | GSC | 1/2 | | | Roberts Bank - Middle Foreslope |
| 14 | 120 m | 402 cm | PISTON | RWE | UofA/GSC | 2, 4, 1 | | | Roberts Bank Channel - Middle/Upper Foreslope |
| 16 | | core not logged | | | GSC | | | | Sturgeon Bank - Lower Foreslope |
| 17 | 126 m | 437 cm | PISTON | RWE | GSC | 2/1 | | | Sturgeon Bank - Middle Foreslope |
| 20 | 173 m | 290 cm | PISTON | GSC | GSC | 4,2 | 1 | | Roberts Bank - Lower Foreslope |
| 21 | 228 m | 503 cm | PISTON | RWE | | 1/2 | | | Roberts Bank - Prodelta |
| 22 | 249 m | 374 cm | PISTON | RWE | GSC | 2, 1, 4 | | | Roberts Bank - Lobe Fringe (?) |
| 23 | 239 m | 387 cm | PISTON | RWE | | 2/1, 4? | 4 | | Roberts Bank - Lobe Fringe (?) |
| 25 | 145 m | 340 cm | PISTON | RWE | | 1, 4, 2 | | | Roberts Bank Interchannel - Middle Foreslope |
| 26 | 160 m | 468 cm | PISTON | RWE | UofA/GSC | 2/1 | | 4? | Roberts Bank Channel - Middle/Lower Foreslope |
| VEC 92A - 20 | 174 m | 230 cm | GRAVITY | GSC | | 2, 4? | 4 | | |
| 34 | 129 m | 375 cm | PISTON | GSC | | 4 | | 1 | |
| 35 | 51 m | 108 cm | PISTON | GSC | | 4, 2 | | 1 | |
| 36 | 44 m | 535 cm | PISTON | RWE | | 4 | 3, 1 | | Roberts Bank Channel Margin - Upper Foreslope |
| 45 | 60 m | 498 cm | PISTON | RWE | GSC | 1, 2 | | 4? | Roberts Bank Interchannel - Upper Foreslope |
| 46 | 59 m | 248 cm | PISTON | RWE | GSC | 4, 1/2, 3 | | | SHSV Flank - Upper Foreslope |
| 47 | 71 m | 514 cm | PISTON | GSC | GSC | 4, 1 | 3 | | SHSV Flank - Upper Foreslope |
| 61 | 152 m | 578 cm | PISTON | RWE | | 1/2 | | 4? | Sturgeon Bank - Middle Foreslope |
| 62 | 36 m | 385 cm | PISTON | GSC | GSC | 1/2 | | 4? | Strugeon Bank - Upper Foreslope |
| 104 | 215 m | 71 cm | GRAVITY | GSC | | 2/1 | | | |
| 105 | 268 m | 80 cm | GRAVITY | GSC | | 1/2 | | | |
| 106 | 281 m | 77 cm | GRAVITY | GSC | | 2/1 | | | |
| 107 | 343 m | 88 cm | GRAVITY | GSC | | 2/1 | | | |
| 108 | 285 m | 88 cm | GRAVITY | GSC | | 2/1 | | | |
| 109 | 253 m | 75 cm | GRAVITY | GSC | | 2/1 | | | |
| 110 | 151 m | 392 cm | PISTON | RWE | GSC | 2/1, 4 | | | SHSV Flank - Lower/Middle Foreslope |
| 112 | 274 m | 580 cm | PISTON | GSC | GSC | 2/1 | | | Basin Floor |
| TUL 92A - 62 | 40 m | 140 cm | VIBRACORE | GSC | | 4, 1 | 2 | | |
| 63 | 80 m | 234 cm | GRAVITY | RWE | | 4, 3 | | | Roberts Bank - Upper Foreslope |

| CORE I.D. | WATER DEPTH | CORE LENGTH | CORE TYPE | LOGGED BY: | GZ Data | FACIES TYPE(S) Major | FACIES TYPE(S) Minor | FACIES TYPE(S) Rare | DEPOSITIONAL SETTING |
|---|---|---|---|---|---|---|---|---|---|
| TUL 92A - 64 | 96 m | 189 cm | GRAVITY | RWE | | 2 | 1 | | |
| 65 | 82 m | 39 cm | GRAVITY | GSC | | 4, 1 | | | SHSV Flank - Upper Foreslope |
| 66 | 68 m | 244 cm | GRAVITY | GSC | | 1/2 | | | |
| 74 | 178 m | 555 cm | PISTON | RWE | | 1/2, 4 | | | SHSV Flank - Lower Foreslope |
| 75 | 52 m | 393 cm | PISTON | GSC | | 3, 1, 4 | | | Sturgeon Bank - Upper Foreslope |
| 76 | 39 m | 410 cm | PISTON | GSC | | 1/2 | 4 | | SHSV Flank - Upper Foreslope |
| 77 | 46 m | 397 cm | PISTON | GSC | | 1/2 | 4? | 4 | Sturgeon Bank - Upper Foreslope |
| 78 | 122 m | 155 cm | PISTON | GSC | | 1/2 | | | Sturgeon Bank - Middle Foreslope |
| 79 | 173 m | 447 cm | PISTON | RWE | *UofA* | 1/2, 4 | | | Roberts Bank Channel - Lower Foreslope |
| 81 | 59 m | 402 cm | PISTON | GSC | | 3, 1 | 4 | | Roberts Bank Interchannel - Upper Foreslope |
| 82 | 55 m | 164 cm | PISTON | RWE | | 4, 1 | 2/3 | | SHSV Flank - Upper Foreslope |
| 83 | 66 m | 138 cm | PISTON | GSC | | 1/2 | | | |
| 84 | 136 m | 232 cm | GRAVITY | RWE | | 1/2, 4? | 4 | | SHSV Flank - Middle Foreslope |
| 103 | 115 m | 63 cm | GRAVITY | RWE | | 1/2, 4 | | | Roberts Bank Interchannel - Middle Foreslope |
| 104 | 153 m | 34 cm | GRAVITY | RWE | | 1/2 | | | SHSV Flank - Middle Foreslope |
| 105 | 140 m | 206 cm | GRAVITY | RWE | | 1/2 | | 4 | SHSV Flank - Middle Foreslope |
| 106 | 107 m | 98 cm | GRAVITY | RWE | | 1/2, 4 | 3? | | SHSV Flank - Middle/Upper Foreslope |
| 107 | 105 m | 198 cm | GRAVITY | RWE | | 1/2 | | 3? | SHSV Flank - Middle Foreslope |
| 108 | 98 m | 194 cm | GRAVITY | RWE | | 1/2 | | | Sturgeon Bank - Upper/Middle Foreslope |
| 109 | 70 m | 191 cm | GRAVITY | RWE | | 1/2 | | | Sturgeon Bank - Upper Foreslope |
| 110 | 55 m | 230 cm | GRAVITY | GSC | | 1/2 | | | Sturgeon Bank - Upper Foreslope |
| 111 | 20 m | 185 cm | GRAVITY | GSC | | 3 | 4? | | Roberts Bank Interchannel - Upper Foreslope |
| 112 | 61 m | 33 cm | GRAVITY | RWE | *UofA* | 1/2 | | | Roberts Bank Interchannel - Upper Foreslope |
| 113 | 59 m | 239 cm | GRAVITY | RWE | | 1/2, 3 | | 4? | Roberts Bank Interchannel - Upper Foreslope |
| 114 | 93 m | 134 cm | GRAVITY | GSC | | 1/2 | 4 | | Roberts Bank Interchannel - Upper Foreslope |
| 162 | 51 m | 215 cm | VIBRACORE | RWE | *UofA* | 2 | 3/4 | | Robert Bank Channel Margin - Upper Foreslope |
| 163 | 54 m | 199 cm | VIBRACORE | RWE | *UofA* | 4, 3 | 1/2 | | Robert Bank Channel Margin - Upper Foreslope |
| 167 | 221 m | 227 cm | GRAVITY | RWE | | 1/2, 4? | 4 | | Roberts Bank - Lobe Fringe |

# APPENDIX B: FRASER RIVER DELTA STUDY
# PISTONCORE/VIBRACORE LOG DESCRIPTIONS

# APPENDIX B1: FRASER DELTA STUDY

## Cruise VEC83B Sedimentologic Core Descriptions.

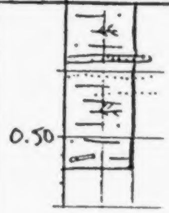
Core No. VEC83B-35 Length 67 cm

Type GRAVITY Water Depth 202m

## GRAPHIC CORE LOG

DEPTH

CLAY SILT VF F M (SAND)



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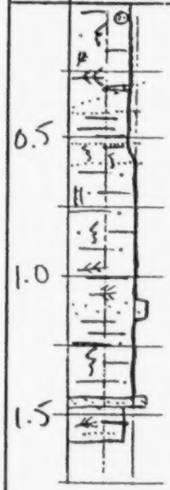
Core No. VEC83B-36 Length 164 cm

Type GRAVITY Water Depth 152 m

## GRAPHIC CORE LOG

DEPTH (m)

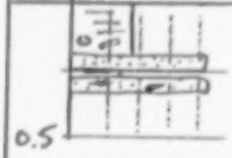
CLAY SILT VF F M (SAND)



Core No. VEC83B-37 Length 31 cm
Type GRAVITY Water Depth 241 m

## GRAPHIC CORE LOG

DEPTH | CLAY SILT (SAND) VF F M



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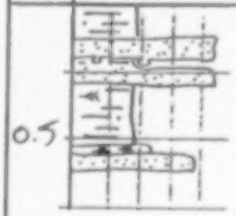
Core No. VEC83B·38 Length 62 cm
Type GRAVITY Water Depth 240 m

## GRAPHIC CORE LOG

DEPTH (m) | CLAY SILT (SAND) VF F M



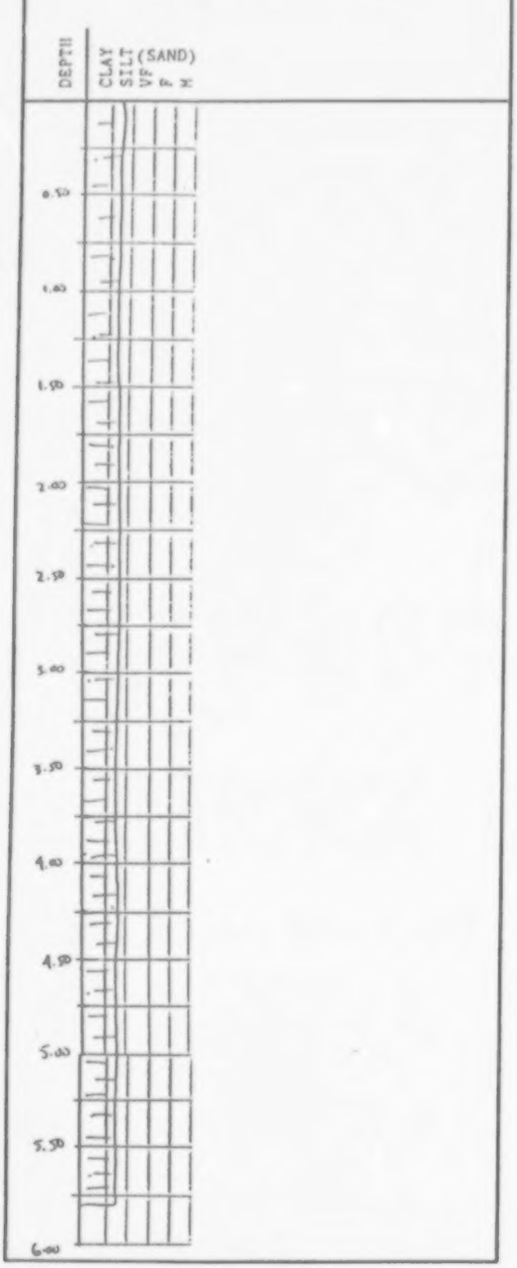
# APPENDIX B2: FRASER DELTA STUDY

## Cruise VEC89A Sedimentologic Core Descriptions

Core No. VEC 89A - 01 Length 5.8 cm

Type PISTON Water Depth 280 m

## GRAPHIC CORE LOG

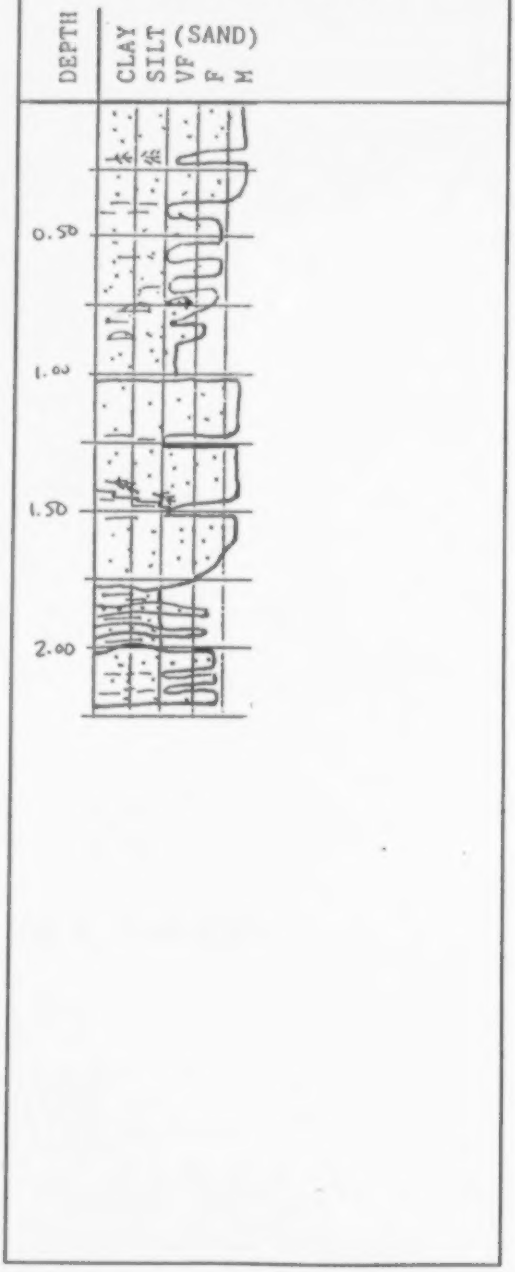

DEPTH
CLAY
SILT
VF
(SAND)
F
M
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
5.00
5.50
6.00

---

Core No. VEC 89A - 03 Length 220 cm

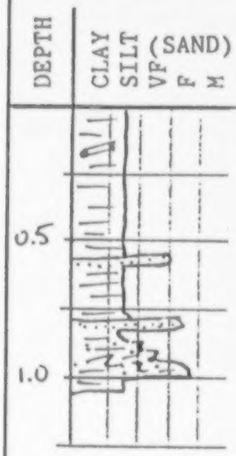
Type PISTON Water Depth 140 m

## GRAPHIC CORE LOG


DEPTH
CLAY
SILT
VF
(SAND)
F
M
0.50
1.00
1.50
2.00

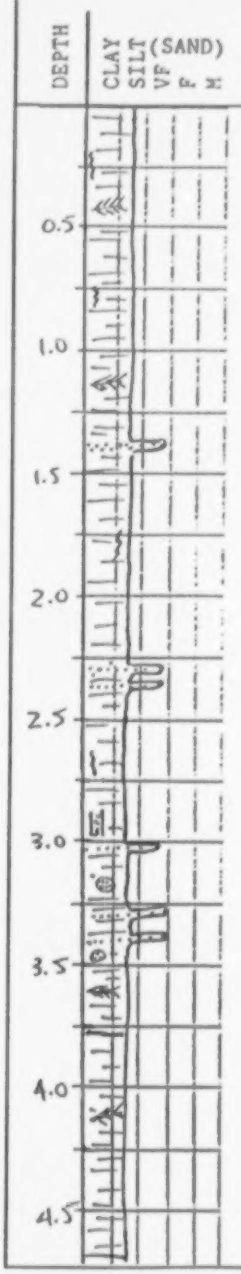
Core No. VEC 89A-06 Length 106 cm
Type PISTON Water Depth______m

## GRAPHIC CORE LOG


DEPTH
CLAY
SILT
(SAND)
VF
F
M
0.5
1.0

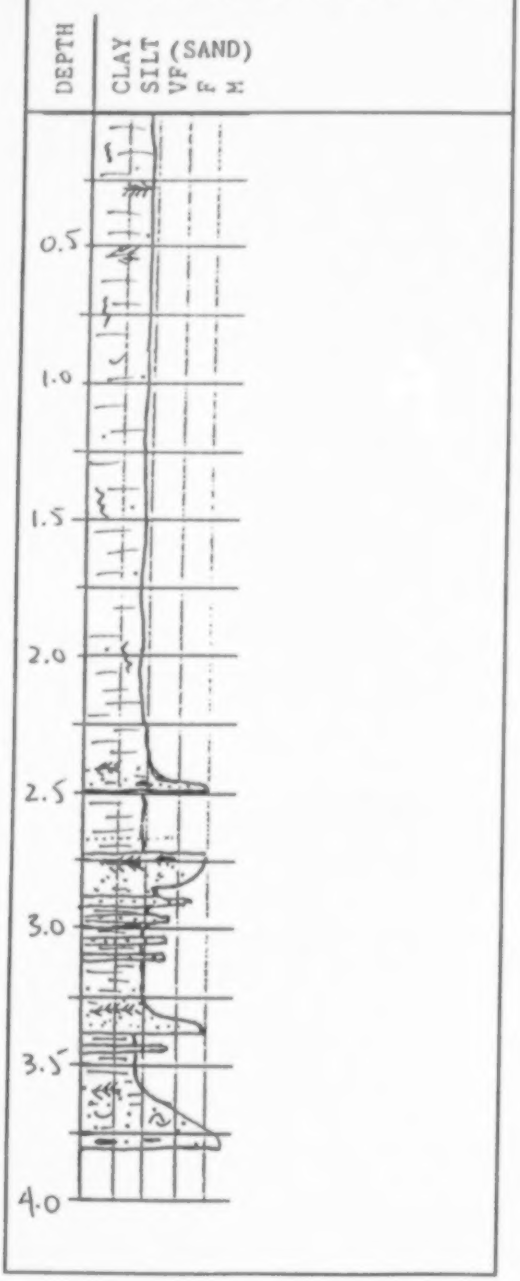
Core No. VEC 89A-07 Length 465 cm
Type PISTON Water Depth _____ m

## GRAPHIC CORE LOG


DEPTH
CLAY
SILT
(SAND)
VF
F
M
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5

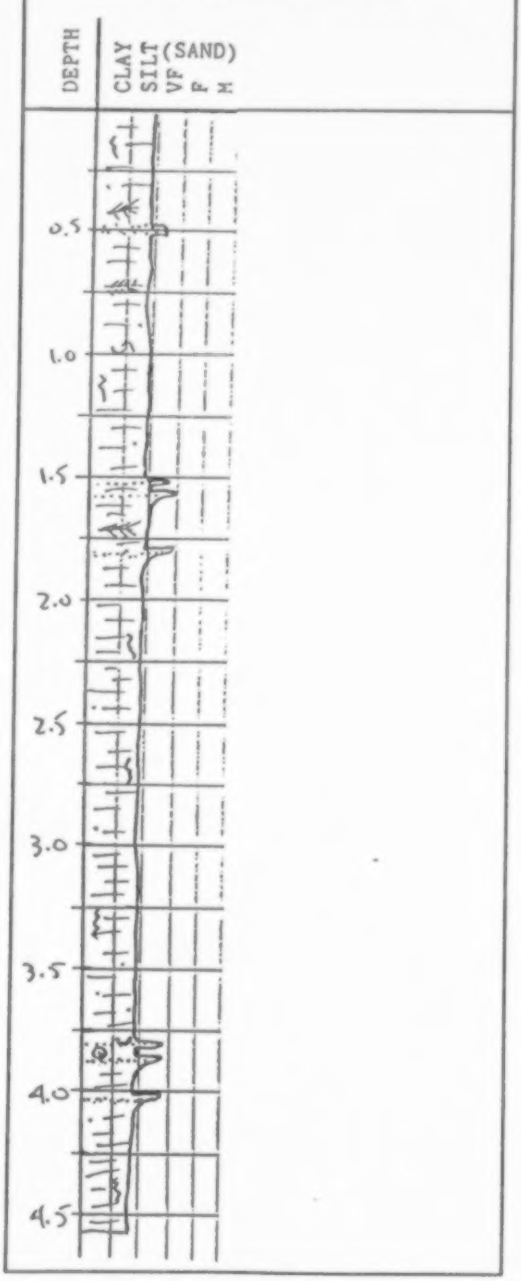
Core No. VEC89 A-18 Length 381 cm
Type PISTON Water Depth 170 m

## GRAPHIC CORE LOG

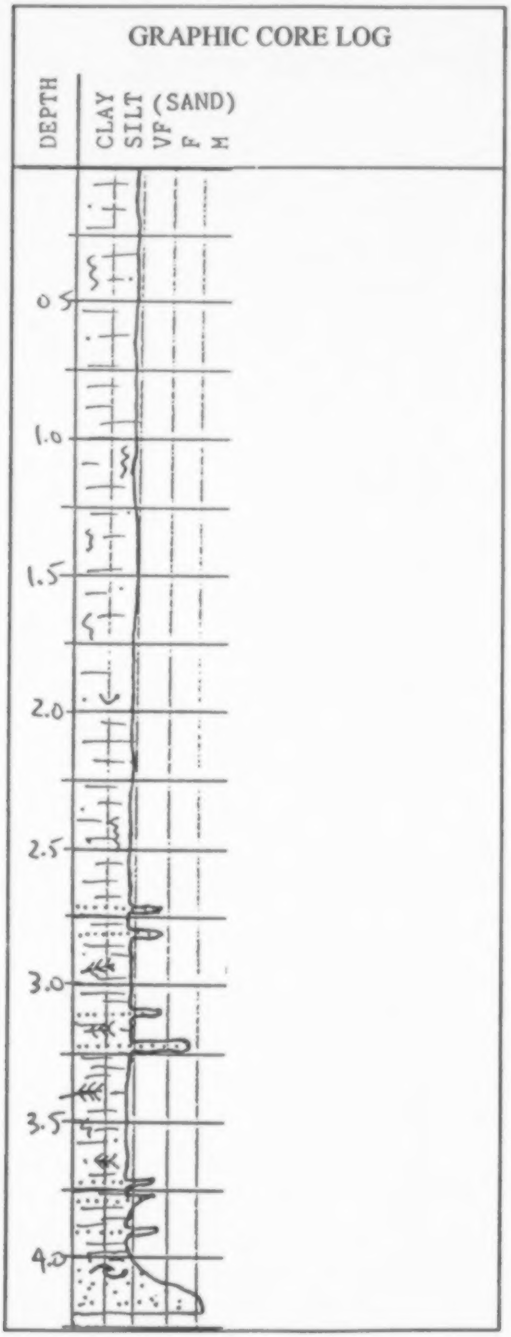

DEPTH
CLAY
SILT
(SAND)
VF
F
M
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0

Core No. VEC89 A-19 Length 460 cm
Type PISTON Water Depth 136 m

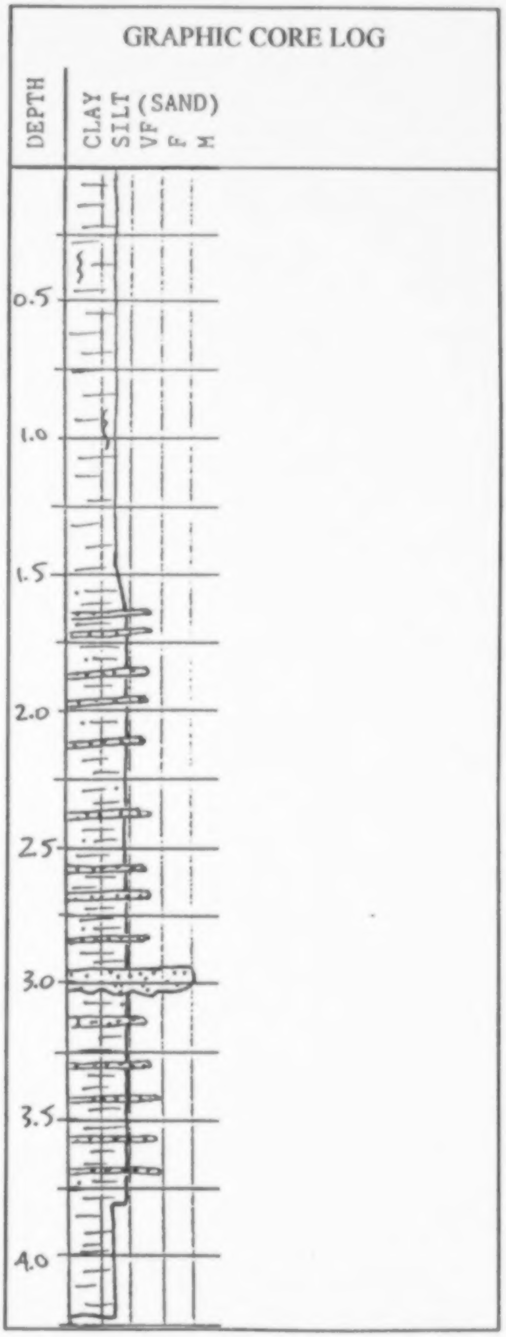
## GRAPHIC CORE LOG


DEPTH
CLAY
SILT
(SAND)
VF
F
M
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5

Core No. VEC89A-20 Length 420 cm
Type PISTON Water Depth 93 m


GRAPHIC CORE LOG
DEPTH
CLAY
SILT
(SAND)
VF
F
M
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0

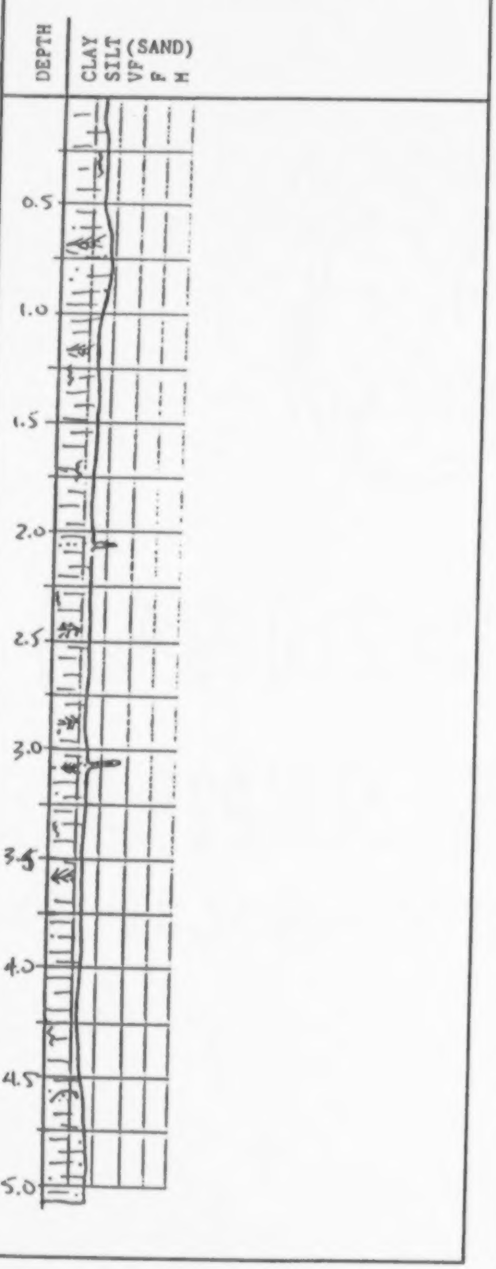
Core No. VEC 89A·21 Length 423 cm
Type PISTON Water Depth 50 m


GRAPHIC CORE LOG
DEPTH
CLAY
SILT
(SAND)
VF
F
M
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0

Core No. VEC 89A-22 Length 510 cm

Type PISTON Water Depth 206 m

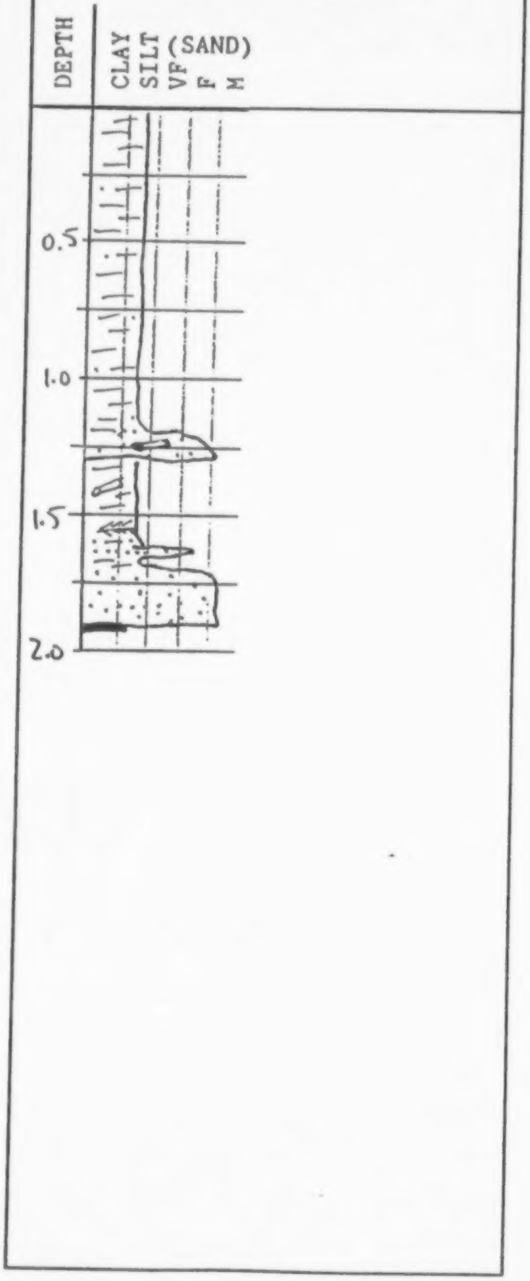
## GRAPHIC CORE LOG


DEPTH
CLAY
SILT
VF
(SAND)
F
M
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0

Core No. VEC 89A-23 Length 188 cm

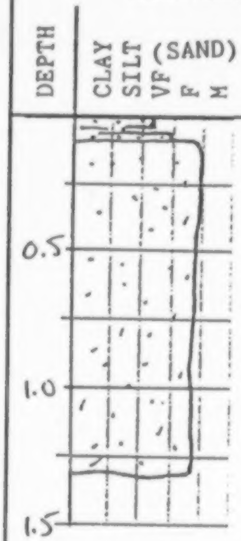
Type PISTON Water Depth 174 m

## GRAPHIC CORE LOG


DEPTH
CLAY
SILT
VF
(SAND)
F
M
0.5
1.0
1.5
2.0

Core No. VEC 89A-25 Length 137 cm
Type PISTON Water Depth 240 m

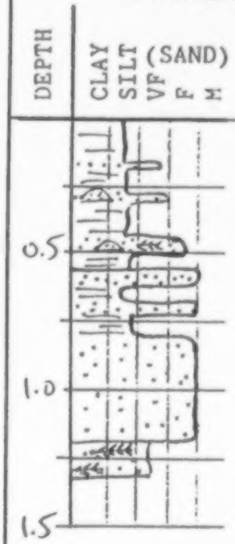
## GRAPHIC CORE LOG


DEPTH
CLAY
SILT
VF
F
M
(SAND)
0.5
1.0
1.5

---

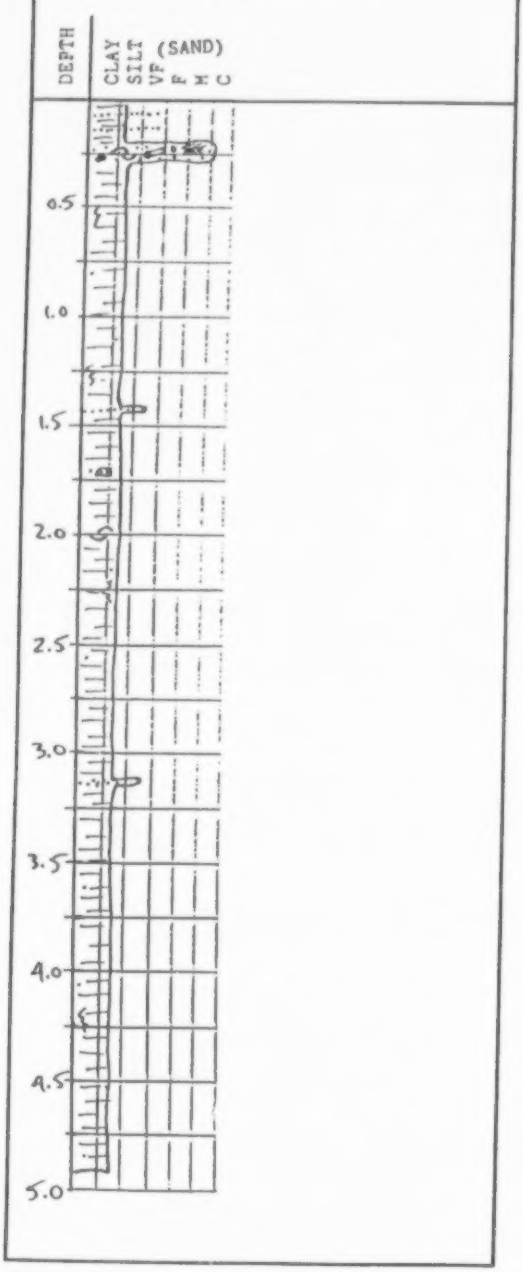
Core No. VEC 89A-39 Length 132 cm
Type PISTON Water Depth 163 m

## GRAPHIC CORE LOG


DEPTH
CLAY
SILT
VF
F
M
(SAND)
0.5
1.0
1.5

Core No. VEC89A-40 Length 486 cm
Type PISTON Water Depth 212 m

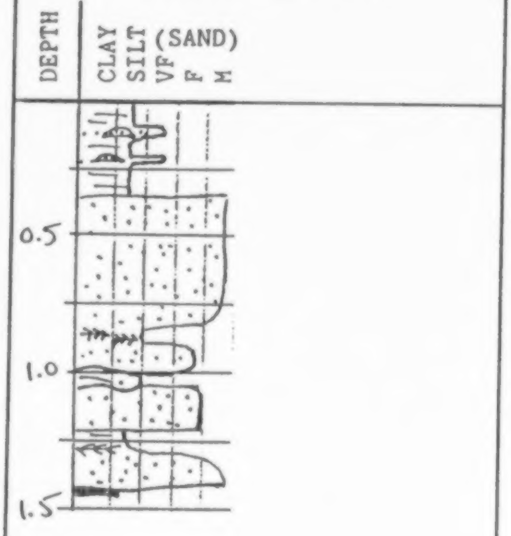
## GRAPHIC CORE LOG


DEPTH
CLAY
SILT
VF
(SAND)
F
M
C
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0

---

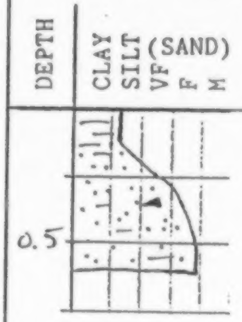
Core No. VEC 89A-41 Length 145 cm
Type PISTON Water Depth _____ m

## GRAPHIC CORE LOG


DEPTH
CLAY
SILT
VF
(SAND)
F
M
0.5
1.0
1.5

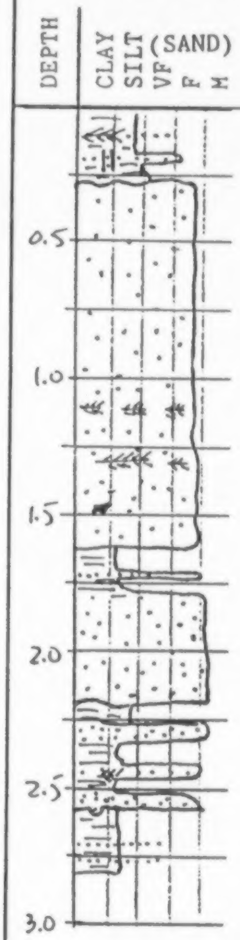
Core No. VEC89A-42 Length 62 cm
Type PISTON Water Depth 176 m

**GRAPHIC CORE LOG**



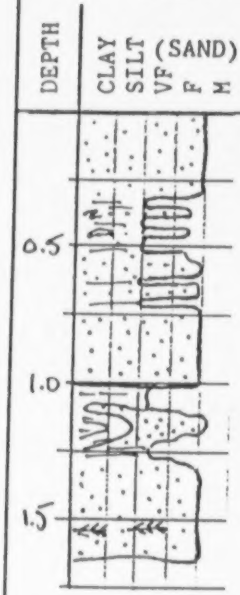
Core No. VEC89A-44 Length 280 cm
Type PISTON Water Depth 182 m

**GRAPHIC CORE LOG**



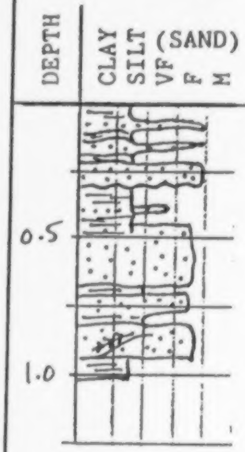
Core No. VEC89A- 45 Length 165 cm
Type DISTON Water Depth 231 m

## GRAPHIC CORE LOG


DEPTH
CLAY
SILT
VF
F
M
(SAND)
0.5
1.0
1.5

Core No. VEC 89A - 46 Length 101 cm
Type PISTON Water Depth 46 m

## GRAPHIC CORE LOG

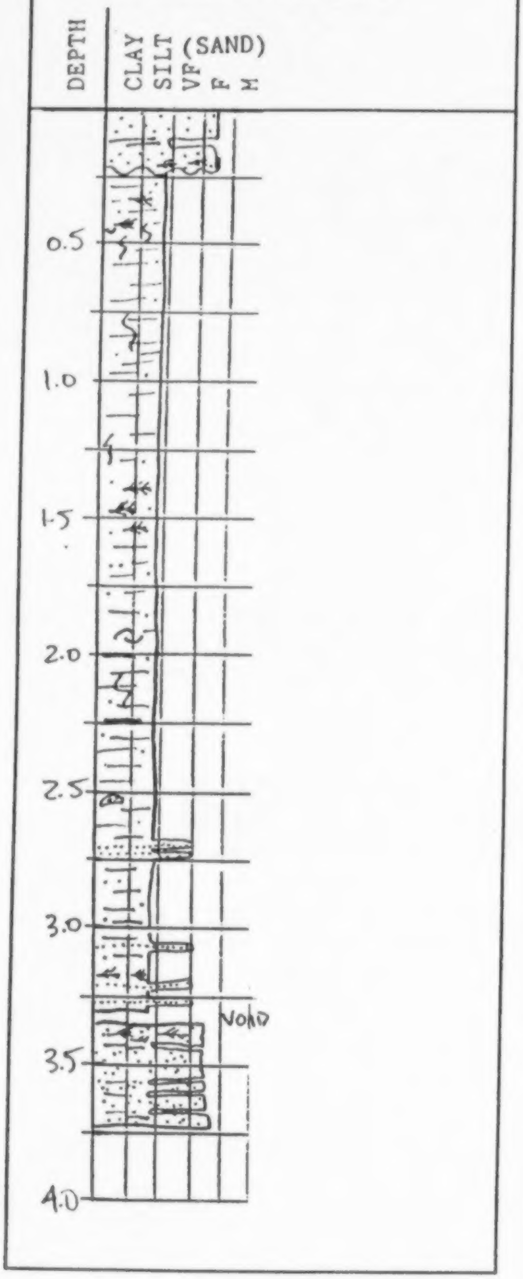

DEPTH
CLAY
SILT
VF
F
M
(SAND)
0.5
1.0

# APPENDIX B3: FRASER DELTA STUDY

## Cruise PAR91A Sedimentologic Core Descriptions

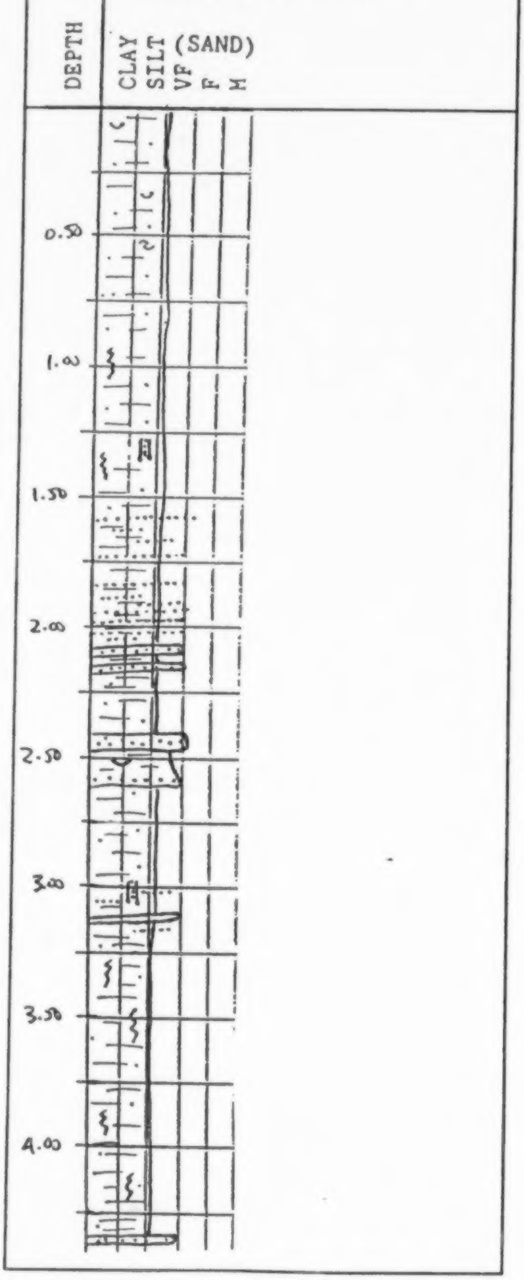
Core No. PAR91A-09 Length 372 cm
Type PISTON Water Depth 188 m

GRAPHIC CORE LOG

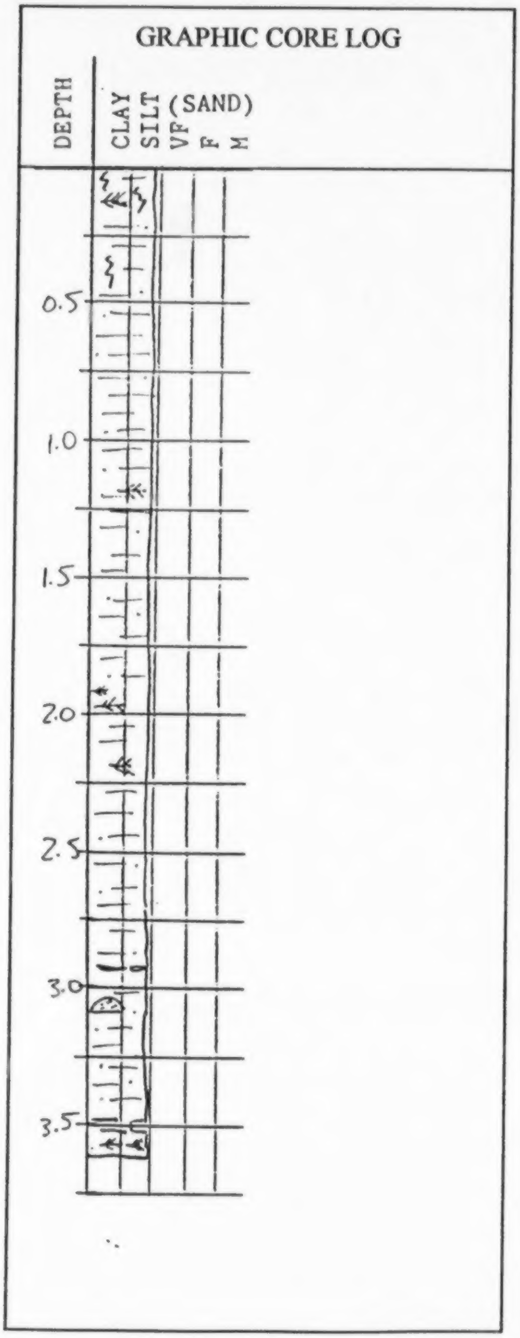

DEPTH
CLAY
SILT
VF
F
M
(SAND)
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
VOID

Core No. PAR91A-11 Length 438 cm
Type PISTON Water Depth 143 m

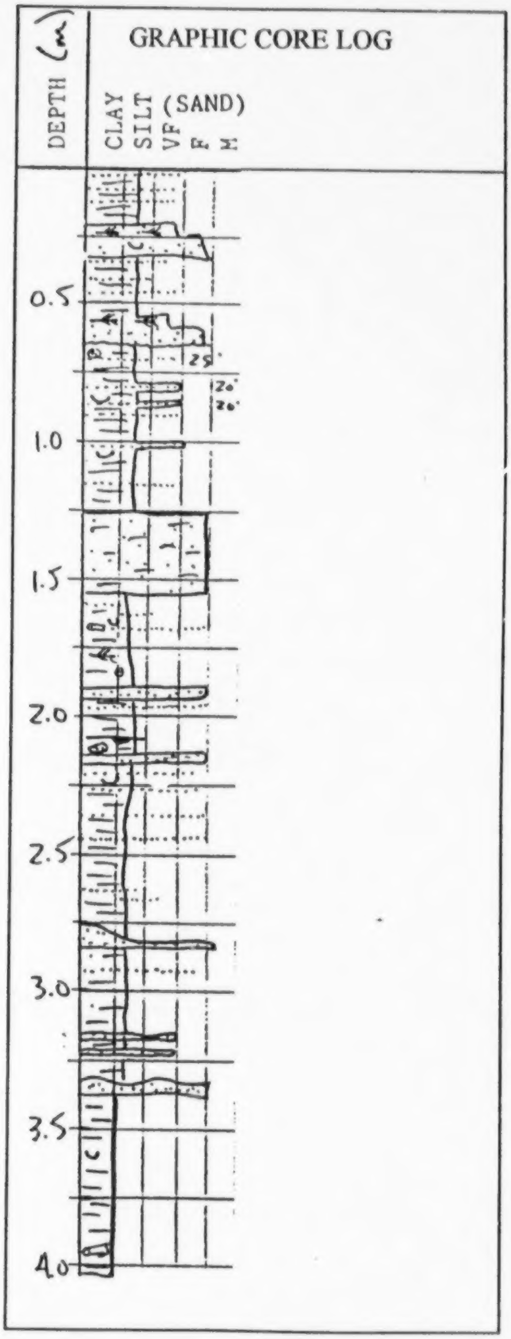
GRAPHIC CORE LOG


DEPTH
CLAY
SILT
VF
F
M
(SAND)
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00

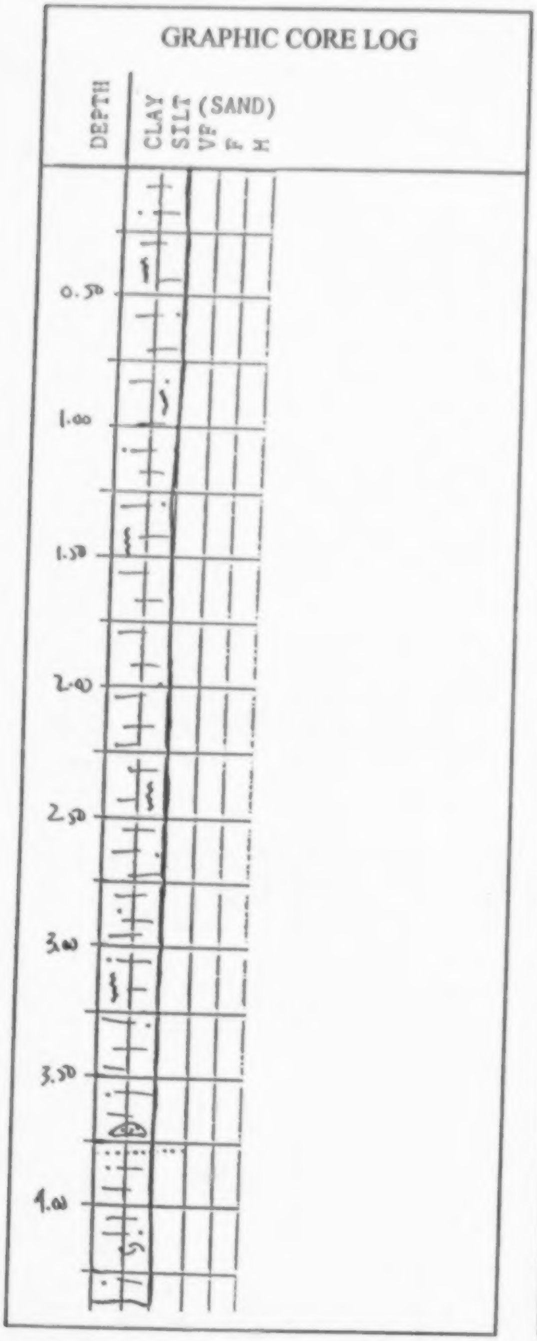
Core No. PAR91A-12 Length 362 cm
Type PISTON Water Depth 120 m


GRAPHIC CORE LOG
DEPTH
CLAY
SILT
(SAND)
VF
F
M
0.5
1.0
1.5
2.0
2.5
3.0
3.5

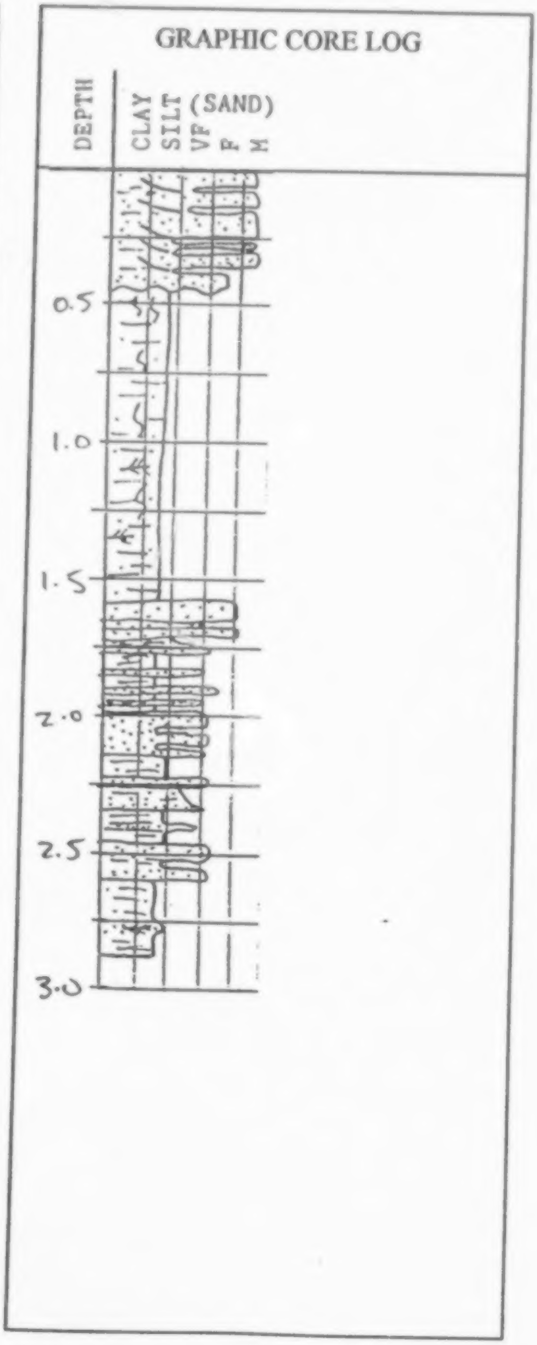
Core No. PAR91A-14 Length 402 cm
Type PISTON Water Depth 120m


GRAPHIC CORE LOG
DEPTH (m)
CLAY
SILT
(SAND)
VF
F
M
0.5
25°
20°
20°
1.0
1.5
2.0
2.5
3.0
3.5
4.0

Core No. PAR91A-17 Length 437 cm
Type PISTON Water Depth 126 m

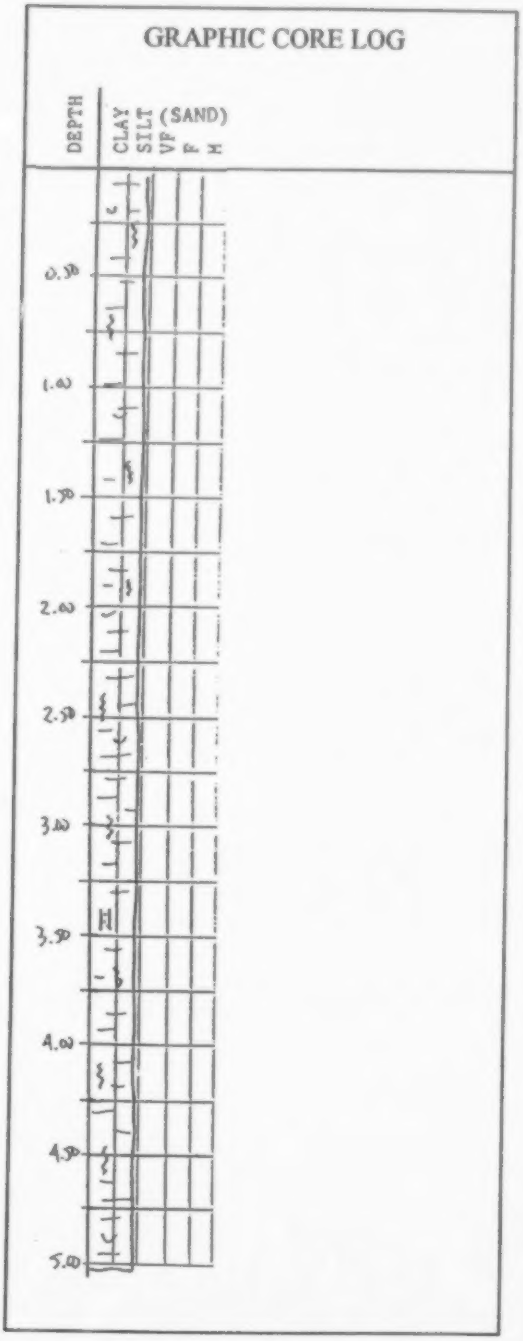

GRAPHIC CORE LOG
DEPTH
CLAY
SILT
VF
F
M
(SAND)
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00

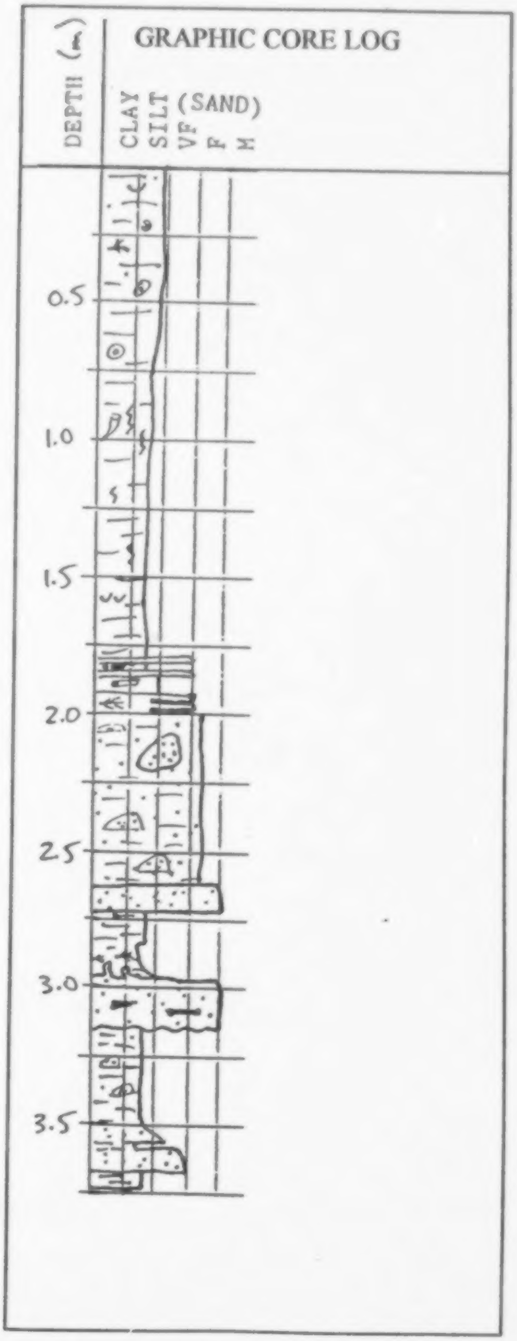
Core No. PAR91A-20 Length 290 cm
Type PISTON Water Depth 173 m


GRAPHIC CORE LOG
DEPTH
CLAY
SILT
VF
F
M
(SAND)
0.5
1.0
1.5
2.0
2.5
3.0

Core No. PAR91A-21 Length 503 cm
Type PISTON Water Depth 228 m

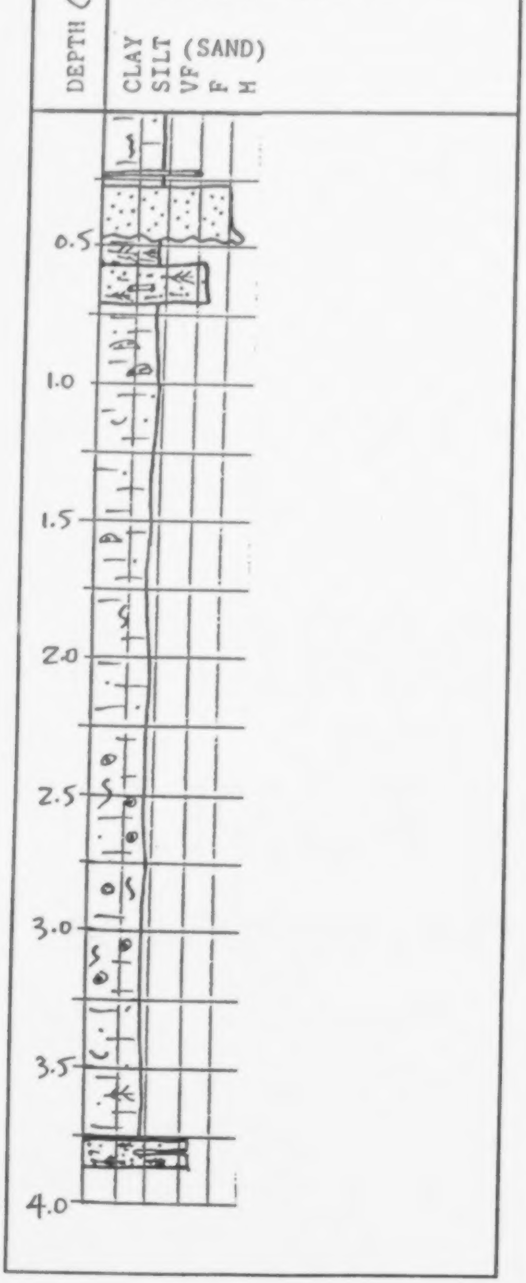
Core No. PAR91A-22 Length 374 cm
Type PISTON Water Depth 249 m


GRAPHIC CORE LOG
DEPTH
CLAY
SILT
(SAND)
VF
F
M
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
5.00


GRAPHIC CORE LOG
DEPTH (m)
CLAY
SILT
(SAND)
VF
F
M
0.5
1.0
1.5
2.0
2.5
3.0
3.5

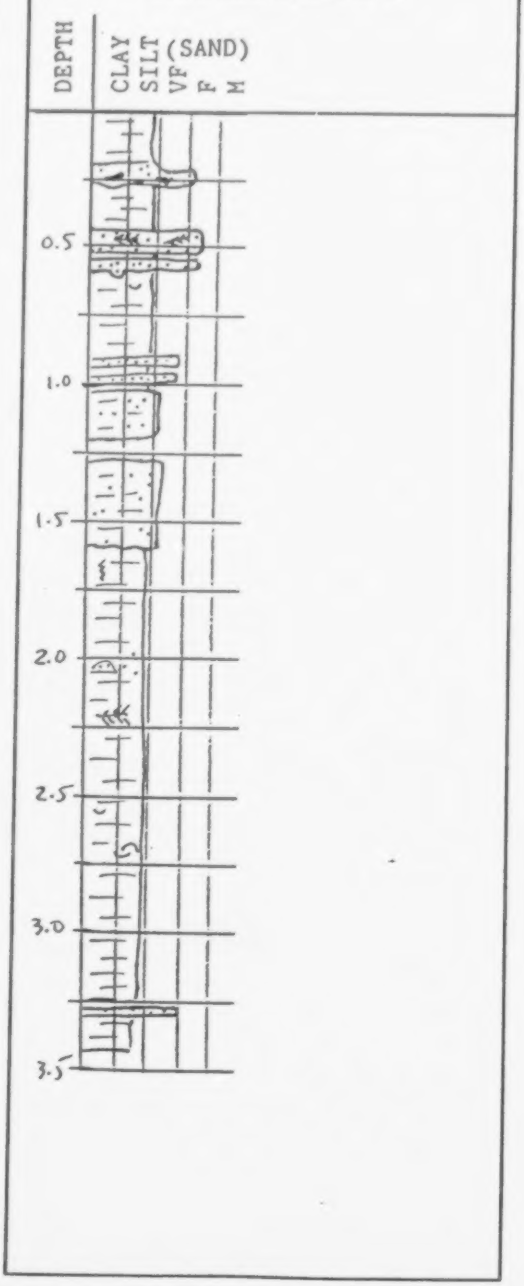
Core No. PAR91A-23 Length 387 cm
Type PISTON Water Depth 239 m

GRAPHIC CORE LOG

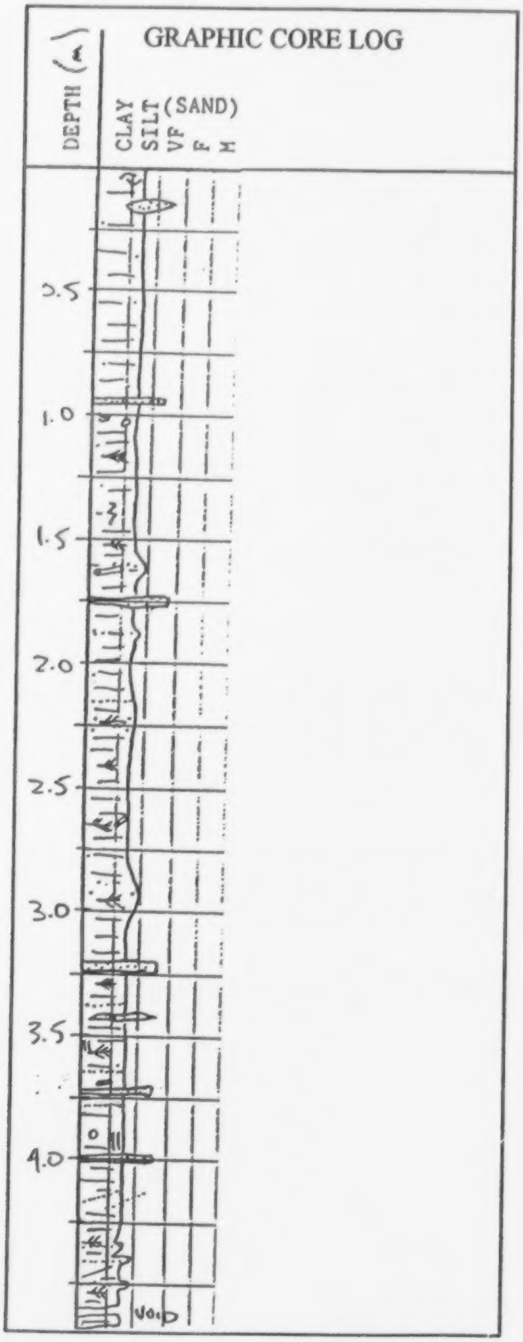

DEPTH (m)
CLAY
SILT
VF
F
M
(SAND)
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0

Core No. PAR91A-25 Length 340 cm
Type PISTON Water Depth 145 m

GRAPHIC CORE LOG


DEPTH
CLAY
SILT
VF
F
M
(SAND)
0.5
1.0
1.5
2.0
2.5
3.0
3.5

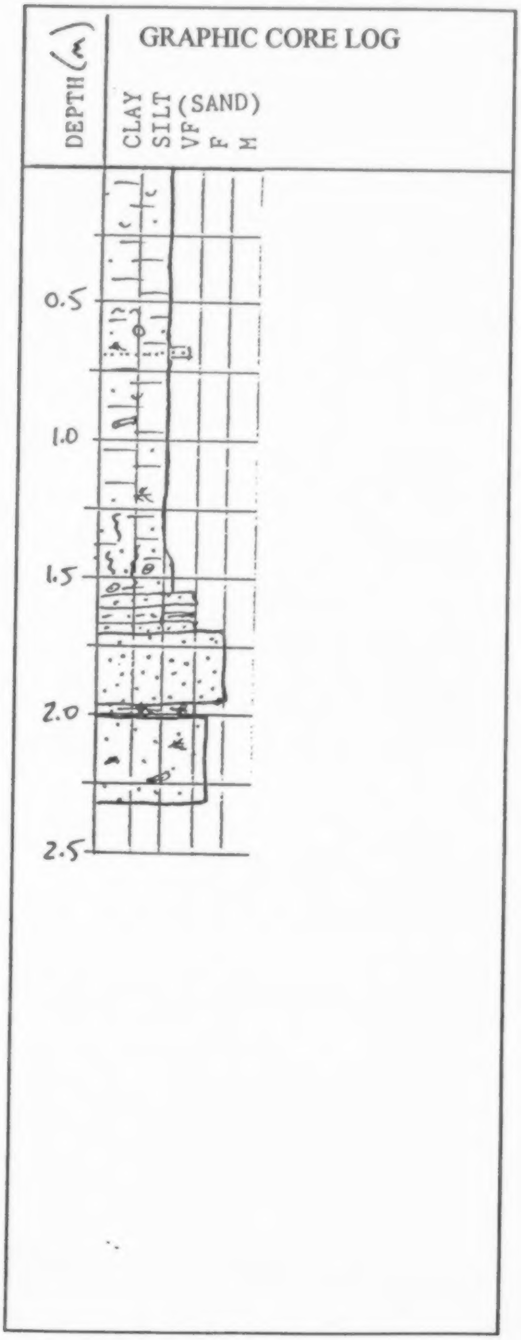
Core No. PAR91A-26 Length 468 cm
Type PISTON Water Depth 160 m


GRAPHIC CORE LOG
DEPTH (m)
CLAY
SILT
(SAND)
VF
F
M
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
VOID

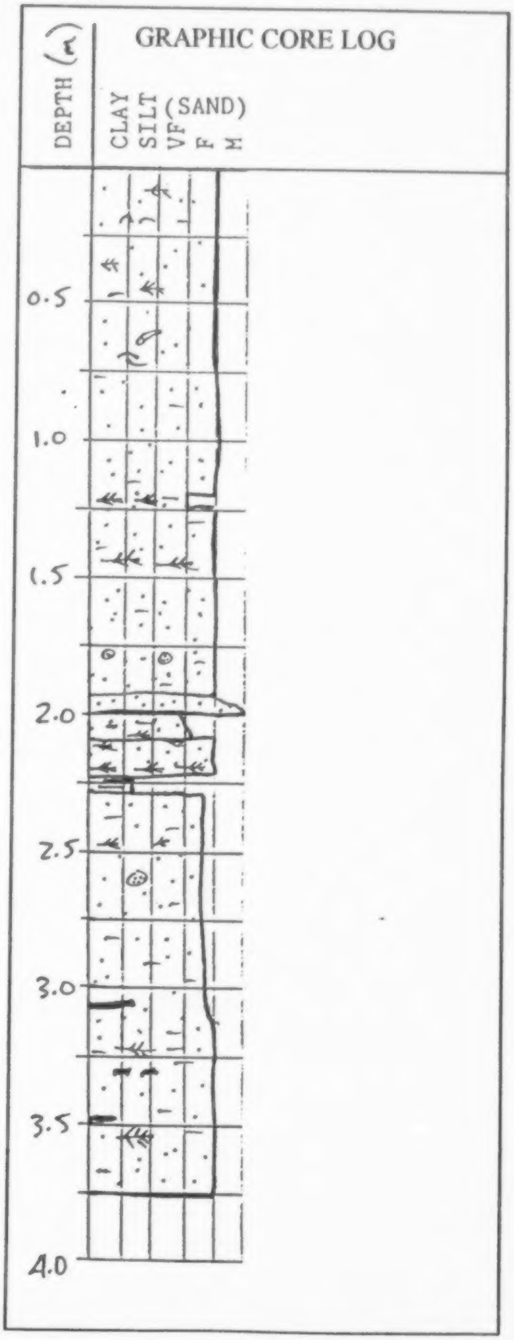
# APPENDIX B4: FRASER DELTA STUDY

## Cruise VEC92A Sedimentologic Core Descriptions

Core No. VEC92A-20 Length 230cm
Type GRAVITY Water Depth 174m

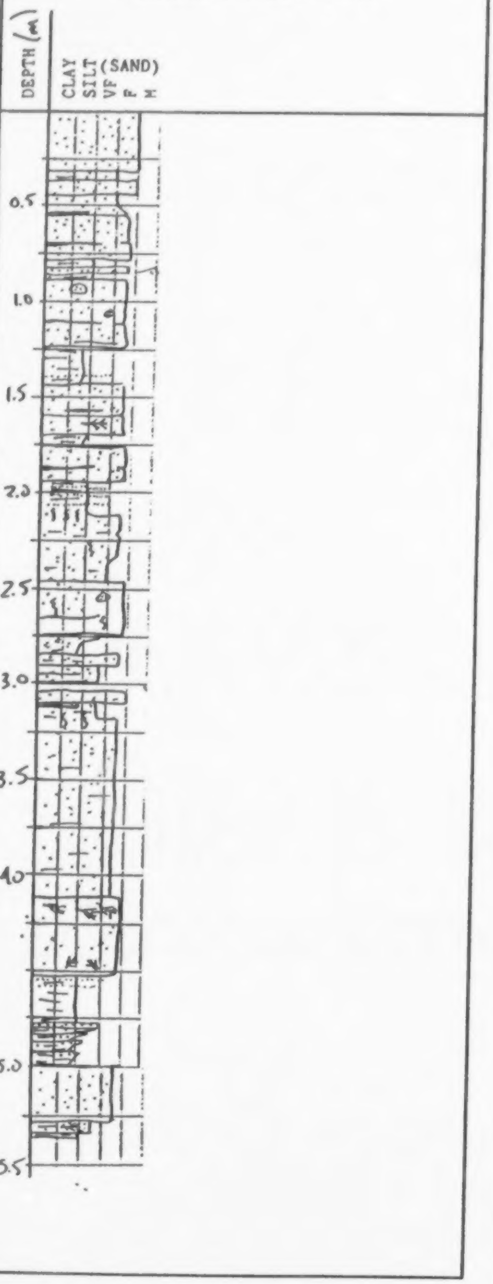

GRAPHIC CORE LOG
DEPTH (m)
CLAY
SILT
VF
F
M
(SAND)
0.5
1.0
1.5
2.0
2.5

Core No. VEC92A-34 Length 375 cm
Type PISTON Water Depth 129 m


GRAPHIC CORE LOG
DEPTH (m)
CLAY
SILT
VF
F
M
(SAND)
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0

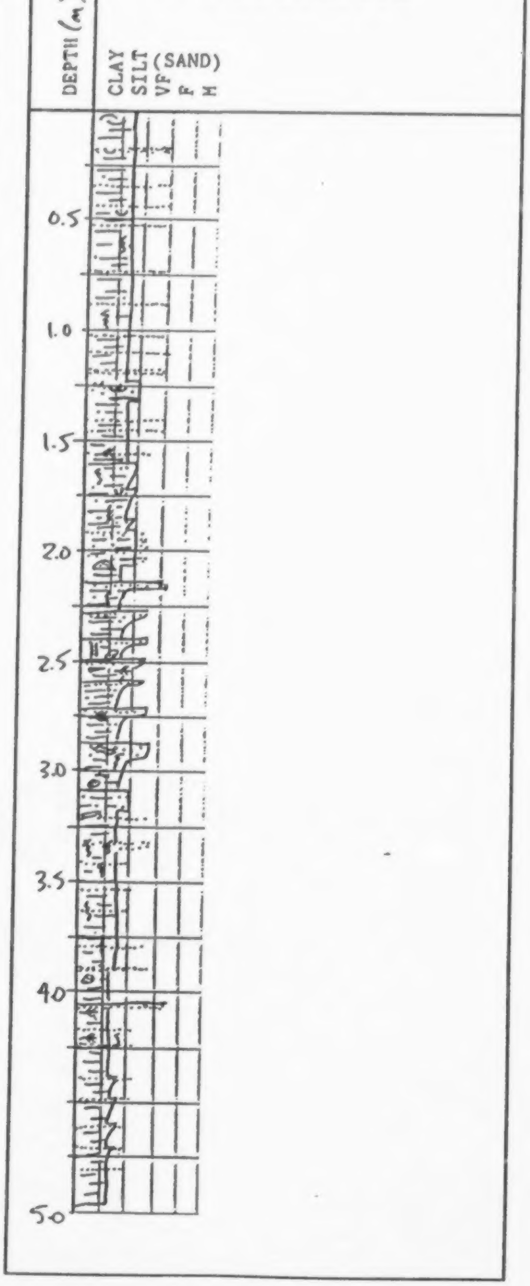
Core No. VEC92A·036 Length 500 cm
Type PISTON Water Depth 44 m

## GRAPHIC CORE LOG

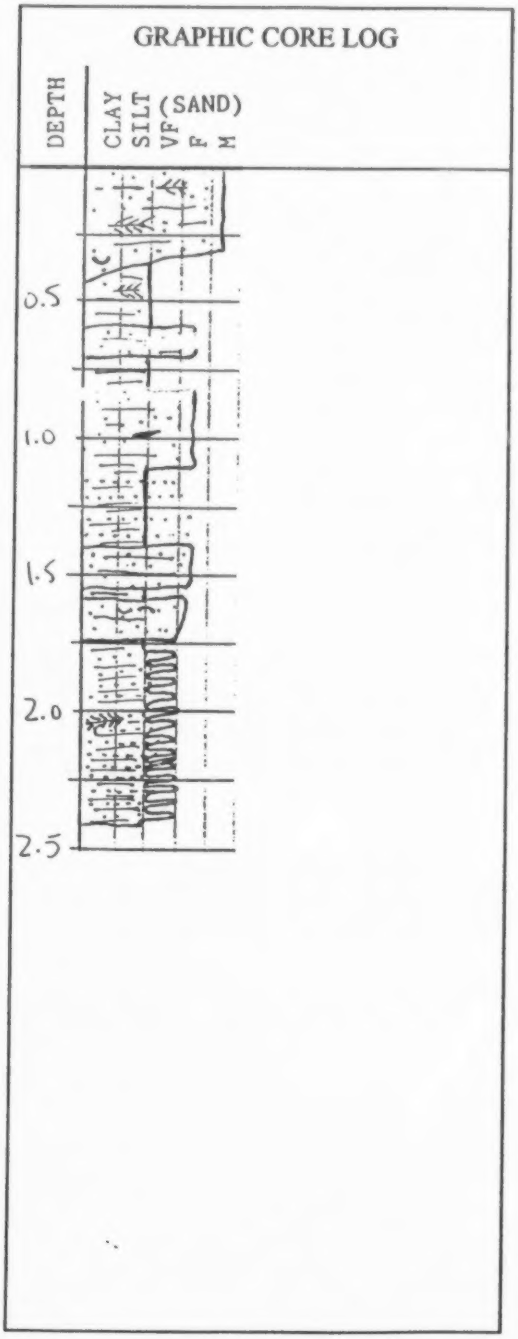

DEPTH (m)
CLAY
SILT
VF (SAND)
F
M
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
5.0
5.5

Core No. VEC92A·45 Length 498 cm
Type PISTON Water Depth 60 m

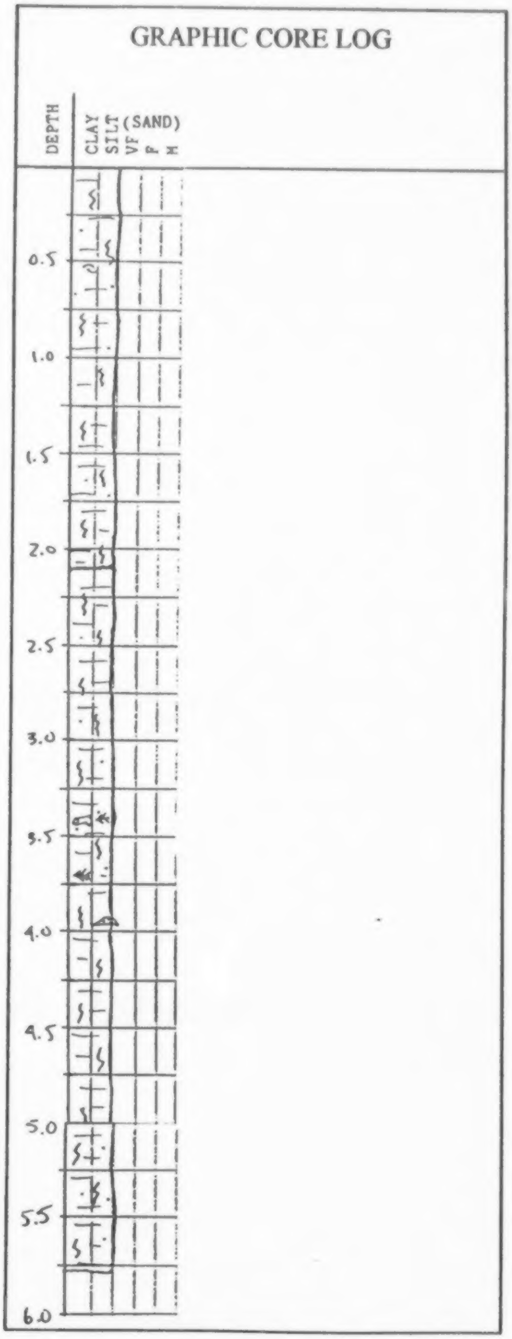
## GRAPHIC CORE LOG


DEPTH (m)
CLAY
SILT
VF (SAND)
F
M
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
5.0

Core No. VEC92A-46 Length 242 cm
Type PISTON Water Depth 59 m

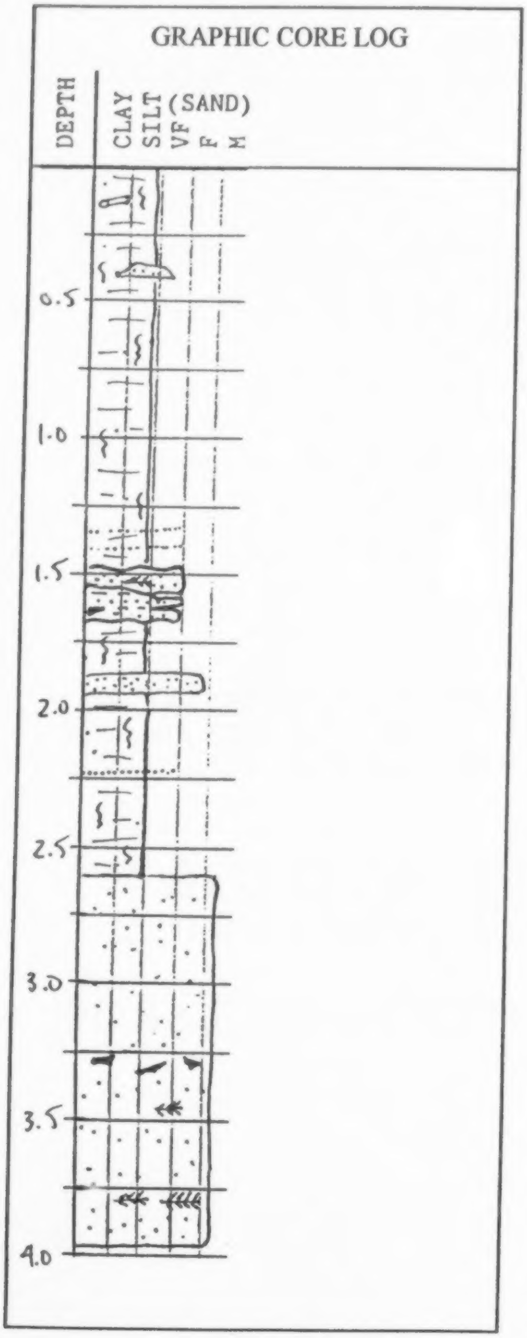

GRAPHIC CORE LOG
DEPTH
CLAY
SILT
VF
F
M
(SAND)
0.5
1.0
1.5
2.0
2.5

Core No. VEC92A-61 Length 578 cm
Type PISTON Water Depth 152 m


GRAPHIC CORE LOG
DEPTH
CLAY
SILT
VF
F
M
(SAND)
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0

Core No. VEC92A-110 Length 392 cm

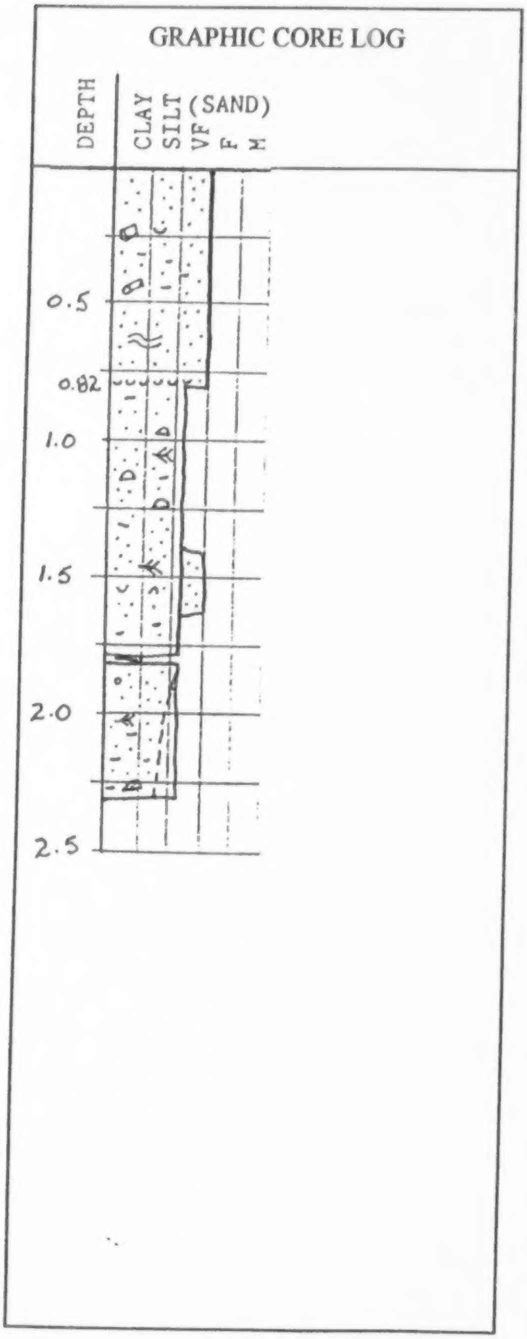
Type PISTON Water Depth 151 m


GRAPHIC CORE LOG
DEPTH
CLAY
SILT
(SAND)
VF
F
M
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0

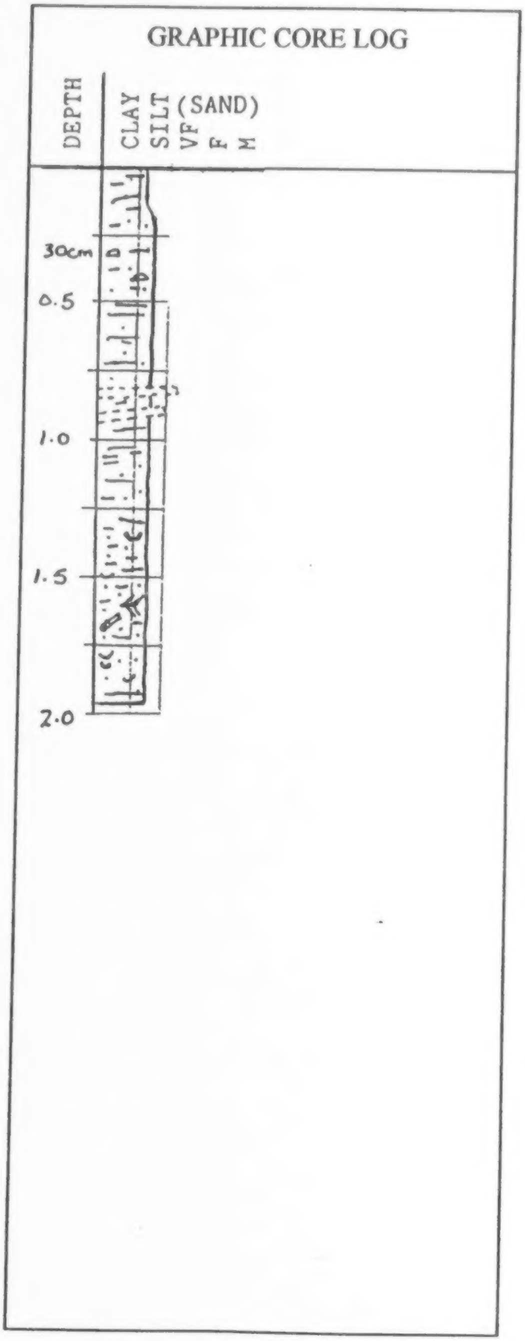
# APPENDIX B5: FRASER DELTA STUDY

## Cruise TUL92A Sedimentologic Core Descriptions

Core No. TUL92A-63 Length 234 cm
Type GRAVITY Water Depth 80 m

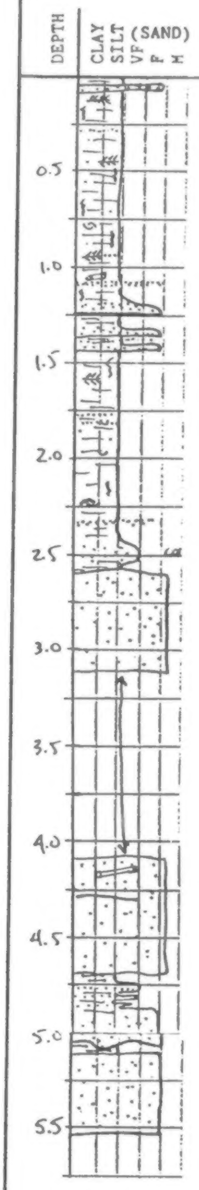

GRAPHIC CORE LOG
DEPTH
CLAY
SILT
(SAND)
VF
F
M
0.5
0.82
1.0
1.5
2.0
2.5

Core No. TUL92A-64 Length 189 cm
Type GRAVITY Water Depth 96 m


GRAPHIC CORE LOG
DEPTH
CLAY
SILT
(SAND)
VF
F
M
30cm
0.5
1.0
1.5
2.0

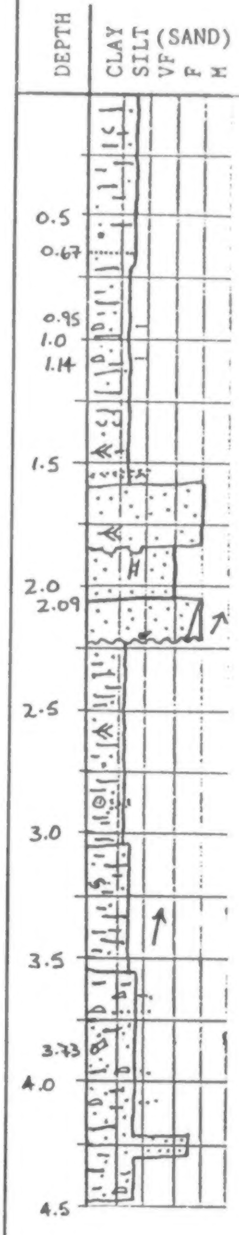
Core No. TUL92A-74 Length 555 cm
Type PISTON Water Depth 178 m

## GRAPHIC CORE LOG


DEPTH
CLAY
SILT
VF
(SAND)
F
M
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5

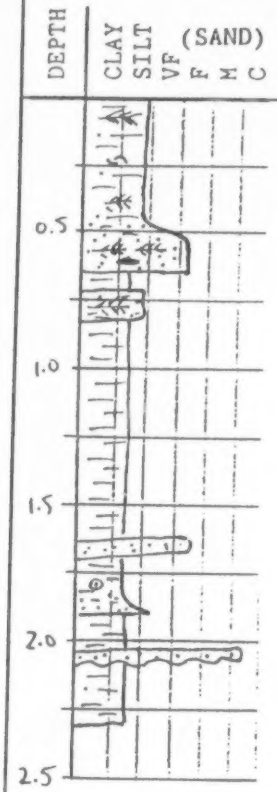
Core No. TUL92A-79 Length 447 cm
Type PISTON Water Depth 173 m

## GRAPHIC CORE LOG


DEPTH
CLAY
SILT
VF
(SAND)
F
M
0.5
0.67
0.95
1.0
1.14
1.5
2.0
2.09
2.5
3.0
3.5
3.73
4.0
4.5

Core No. TUL92A-84 Length 232 cm
Type GRAVITY Water Depth 136 m

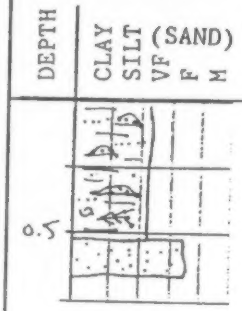
## GRAPHIC CORE LOG


DEPTH
CLAY
SILT
(SAND)
VF
F
M
C
0.5
1.0
1.5
2.0
2.5

---

Core No. TUL92A-103 Length 63 cm
Type GRAVITY Water Depth 115 m

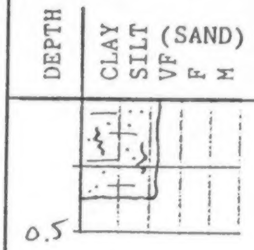
## GRAPHIC CORE LOG


DEPTH
CLAY
SILT
(SAND)
VF
F
M
0.5

Core No. TUL92A-104 Length 34 cm

Type GRAVITY Water Depth 153 m

## GRAPHIC CORE LOG

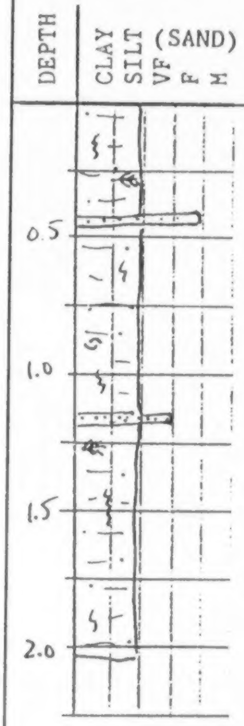

DEPTH
CLAY
SILT
VF
F
M
(SAND)
0.5

---

Core No. TUL92A-105 Length 206 cm

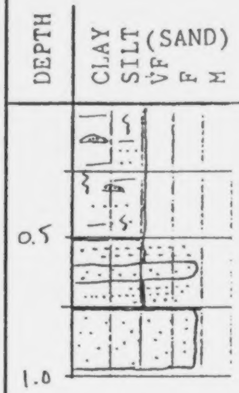
Type GRAVITY Water Depth 140 m

## GRAPHIC CORE LOG


DEPTH
CLAY
SILT
VF
F
M
(SAND)
0.5
1.0
1.5
2.0

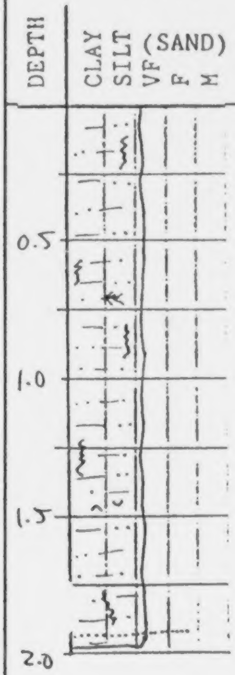
Core No. TUL92A-106 Length 98 cm
Type GRAVITY Water Depth 107 m

## GRAPHIC CORE LOG


DEPTH
CLAY
SILT
VF
F
M
(SAND)
0.5
1.0

Core No. TUL92A-107 Length 198 cm
Type GRAVITY Water Depth 105 m

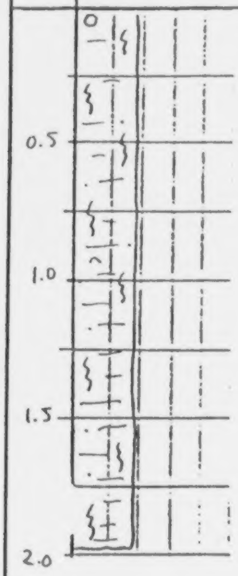
## GRAPHIC CORE LOG


DEPTH
CLAY
SILT
VF
F
M
(SAND)
0.5
1.0
1.5
2.0

Core No. TUL92A-108 Length 194 cm
Type GRAVITY Water Depth 98 m

### GRAPHIC CORE LOG

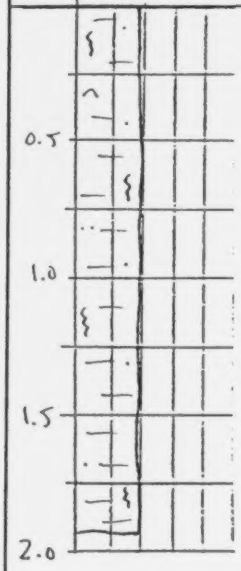
DEPTH CLAY SILT VF F M (SAND)



Core No. TUL92A-109 Length 191 cm
Type GRAVITY Water Depth 70 m

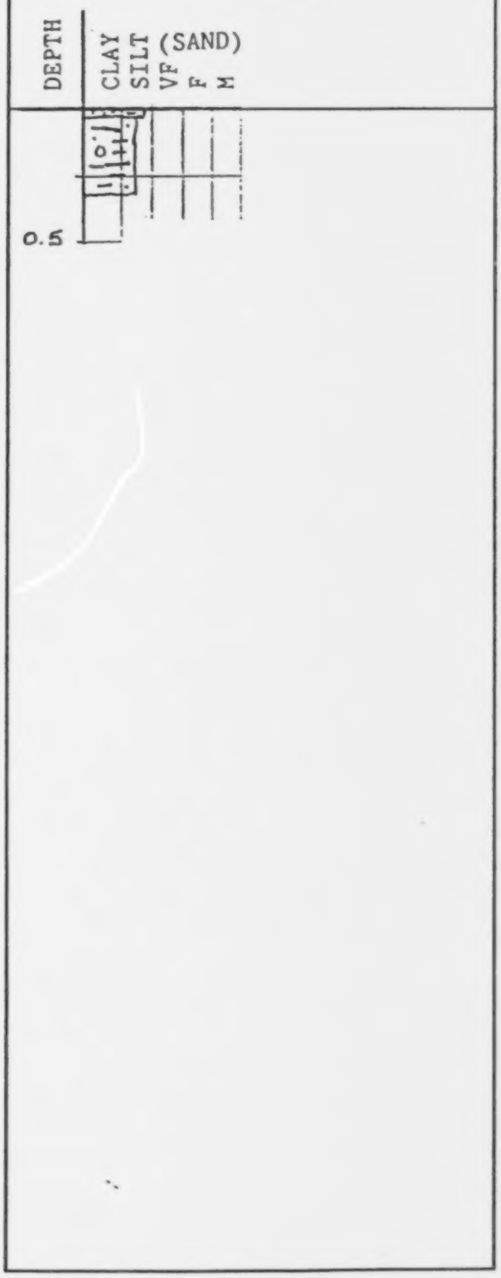
### GRAPHIC CORE LOG

DEPTH CLAY SILT VF F M (SAND)



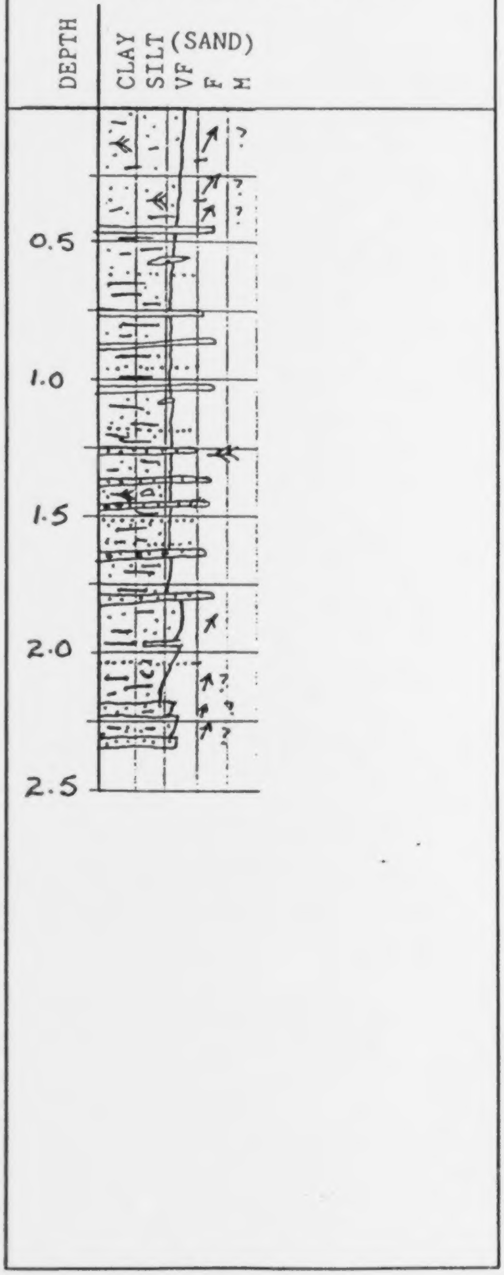
Core No. TUL92A-112 Length 33 cm
Type GRAVITY Water Depth 61 m

GRAPHIC CORE LOG


DEPTH
CLAY
SILT
(SAND)
VF
F
M
0.5

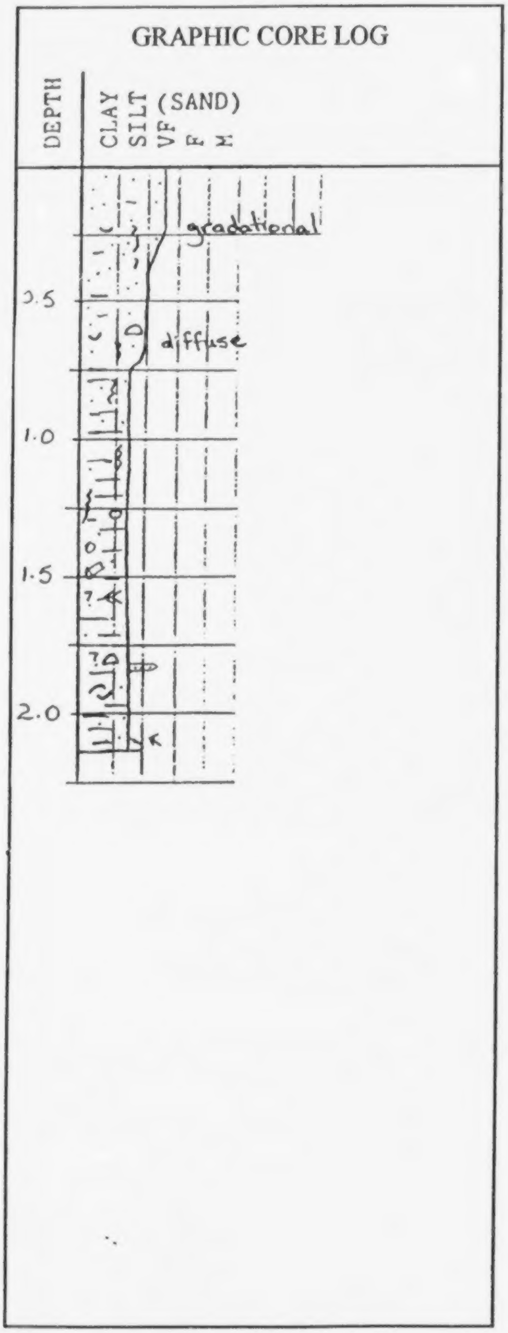
Core No. TUL92A-113 Length 239 cm
Type GRAVITY Water Depth 59 m

GRAPHIC CORE LOG


DEPTH
CLAY
SILT
(SAND)
VF
F
M
0.5
1.0
1.5
2.0
2.5
?

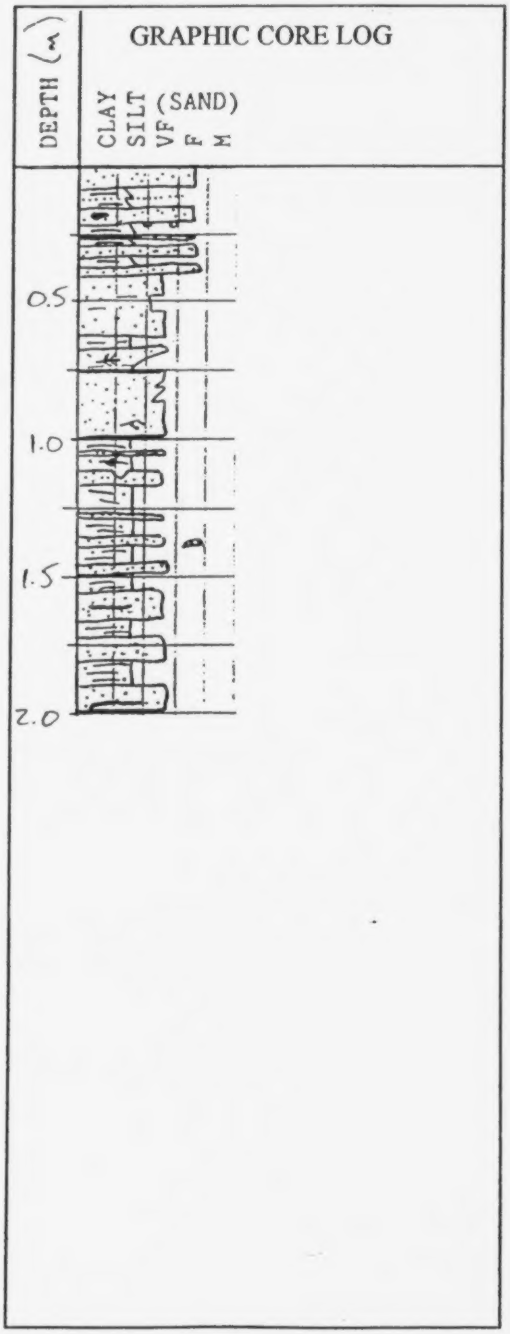
Core No. TUL92A-162 Length 215 cm
Type VIBRACORE Water Depth 51 m

GRAPHIC CORE LOG


DEPTH
CLAY
SILT
VF
F
M
(SAND)
gradational
0.5
diffuse
1.0
1.5
2.0

Core No. TUL92A-163 Length 199 cm
Type VIBRACORE Water Depth 54 m

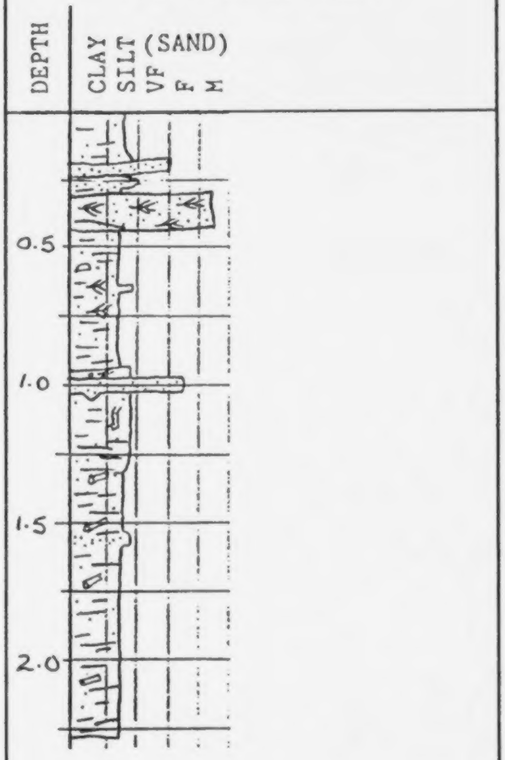
GRAPHIC CORE LOG


DEPTH (m)
CLAY
SILT
VF
F
M
(SAND)
0.5
1.0
1.5
2.0

Core No. TUL92A-167 Length 227 cm

Type GRAVITY Water Depth 221 m

GRAPHIC CORE LOG


DEPTH
CLAY
SILT
VF
F
M
(SAND)
0.5
1.0
1.5
2.0

# APPENDIX C: FRASER RIVER DELTA STUDY

## SUMMARY OF GRAIN SIZE ANALYSIS DATA

# APPENDIX C1: FRASER RIVER DELTA STUDY
## RAW GRAIN SIZE DATA

| core | interval | -1.0 phi | -1.0 - 1.0 | .0 - 2.0 | .0 - 3.0 | 3.0 - 4.0 | 4.0 - 5.0 | 5.0 - 6.0 |
|---|---|---|---|---|---|---|---|---|
| VEC89A-01 | 0 - 5 |  | 0.06 | 0.29 | 1.12 | 18.27 | 6.42 | 3.45 |
|  | 573 - 580 |  | 0.13 | 0.90 | 1.82 | 24.40 | 4.15 | 2.25 |
| VEC89A-03 | 8 - 12 |  | 0.13 | 0.50 | 10.42 | 47.28 | 9.08 | 3.29 |
|  | 12 - 15 | 0.08 | 0.68 | 0.68 | 27.40 | 58.83 | 5.53 | 1.21 |
|  | 30 - 31 |  | 0.25 | 0.51 | 5.02 | 32.30 | 9.54 | 3.96 |
|  | 35 - 40 | 0.01 | 0.19 | 0.34 | 5.14 | 38.70 | 12.74 | 4.39 |
|  | 70 - 72 |  | 0.57 | 1.06 | 26.00 | 55.32 | 6.38 | 1.67 |
|  | 75 - 80 | 0.38 | 0.51 | 0.56 | 13.26 | 50.71 | 11.35 | 3.49 |
|  | 95 - 97 |  | 0.03 | 2.18 | 7.84 | 30.55 | 9.03 | 3.62 |
|  | 110 | 0.32 | 1.59 | 23.63 | 44.02 | 23.06 | 2.79 | 0.71 |
|  | 116 |  | 0.31 | 0.35 | 7.67 | 7.75 | 4.45 | 2.69 |
|  | 125 |  | 0.46 | 23.98 | 55.31 | 17.69 |  |  |
|  | 145 |  | 0.65 | 24.74 | 53.31 | 17.86 |  |  |
|  | 170 | 1.32 | 7.14 | 18.86 | 35.83 | 26.83 | 3.27 | 1.16 |
|  | 173 | 0.04 | 0.28 | 3.15 | 13.14 | 42.40 | 8.98 | 3.24 |
|  | 210 | 0.87 | 1.73 | 42.18 | 43.60 | 9.84 |  |  |
|  | 220 |  | 0.09 | 10.11 | 26.34 | 21.44 | 5.42 | 2.61 |
| VEC89A-06 | 35 |  |  | 0.27 | 3.07 | 28.74 | 9.58 | 4.27 |
|  | 66 |  |  | 1.27 | 22.71 | 62.87 |  |  |
|  | 100 |  | 0.31 | 5.63 | 27.58 | 25.59 | 4.29 | 2.17 |
| VEC89A-07 | 285 - 295 |  | 0.07 | 0.35 | 2.25 | 29.60 | 3.52 | 2.30 |
|  | 332 |  | 0.06 | 0.07 | 1.46 | 32.55 | 3.82 | 1.98 |
|  | 380 - 390 |  |  | 0.20 | 0.50 | 25.48 | 7.90 | 3.54 |
| VEC89A-18 | 50 |  |  | 0.06 | 0.48 | 11.83 | 6.84 | 3.59 |
|  | 245 |  | 0.30 | 7.09 | 18.64 | 50.02 | 10.42 | 2.64 |
|  | 260 |  |  | 0.49 | 2.08 | 19.18 | 5.40 | 2.97 |
|  | 330 |  | 1.00 | 13.86 | 34.56 | 36.86 | 5.72 | 1.39 |
|  | 360 |  | 0.65 | 22.11 | 44.88 | 28.45 |  |  |
|  | 375 - 380 | 0.03 | 0.66 | 15.84 | 41.65 | 36.33 | 1.74 | 0.43 |
| VEC89A-20 | 295 |  | 0.02 | 0.00 | 1.13 | 26.37 | 8.91 | 4.35 |
|  | 400 |  |  | 2.34 | 50.66 | 42.04 | 1.57 | 0.37 |
|  | 420 | 0.11 | 0.47 | 1.34 | 33.35 | 50.09 | 4.98 | 1.42 |
| VEC89A-21 | 50 - 55 |  |  | 0.46 | 1.52 | 15.88 | 6.82 | 3.37 |
|  | 90 - 95 |  | 0.10 | 0.05 | 1.21 | 21.87 | 8.91 | 4.15 |
|  | 300 - 305 |  |  | 2.58 | 3.22 | 22.59 | 8.45 | 3.72 |
|  | 307 - 310 |  |  | 5.15 | 9.66 | 24.55 | 8.00 | 3.70 |
| VEC89A-23 | 127 | 0.23 | 1.99 | 5.82 | 14.34 | 56.71 | 8.80 | 2.05 |
|  | 150 |  | 0.06 | 0.67 | 2.80 | 14.81 | 5.55 | 2.86 |
|  | 180 |  | 0.64 | 12.72 | 40.17 | 36.15 | 3.60 | 0.92 |
| VEC89A-25 | 15 |  | 1.60 | 37.17 | 52.25 | 7.40 |  |  |
|  | 70 |  | 1.67 | 46.87 | 44.83 | 6.15 |  |  |
|  | 130 |  | 1.42 | 45.09 | 47.71 | 5.26 |  |  |

| core | interval | 6.0 - 7.0 | 7.0 - 8.0 | 8.0 - 9.0 | 9.0 - 10.0 | 0.0 - 11.0 | 11.0 - 12.0 | >12.0 |
|---|---|---|---|---|---|---|---|---|
| VEC89A-01 | 0 - 5 | 15.25 | 14.68 | 16.21 | 4.01 | 4.90 | 4.25 | 9.55 |
| | 573 - 580 | 10.98 | 12.22 | 16.73 | 4.95 | 5.82 | 3.86 | 10.83 |
| VEC89A-03 | 8 - 12 | 8.96 | 5.50 | 4.54 | 1.17 | 1.38 | 0.83 | 4.83 |
| | 12 - 15 | 2.10 | 0.73 | 0.56 | 0.10 | 0.25 | 0.15 | 0.16 |
| | 30 - 31 | 14.24 | 10.59 | 10.34 | 2.54 | 3.84 | 2.48 | 3.16 |
| | 35 - 40 | 13.29 | 8.57 | 7.45 | 1.50 | 2.39 | 1.22 | 1.11 |
| | 70 - 72 | 3.33 | 1.47 | 1.16 | 0.39 | 0.56 | 0.24 | 0.78 |
| | 75 - 80 | 8.16 | 3.98 | 3.39 | 0.62 | 0.97 | 0.38 | 0.00 |
| | 95 - 97 | 12.30 | 9.86 | 10.81 | 2.61 | 3.68 | 2.91 | 2.73 |
| | 110 | 1.57 | 0.55 | 0.38 | 0.11 | 0.11 | 0.06 | 0.59 |
| | 116 | 16.70 | 20.81 | 20.90 | 4.53 | 6.29 | 3.44 | 3.36 |
| | 125 | | | | | | | |
| | 145 | | | | | | | |
| | 170 | 2.55 | 1.12 | 0.82 | 0.14 | 0.24 | 0.16 | 0.18 |
| | 173 | 9.02 | 5.86 | 5.62 | 1.39 | 2.30 | 1.43 | 1.72 |
| | 210 | | | | | | | |
| | 220 | 10.13 | 8.61 | 7.35 | 1.60 | 2.27 | 1.43 | 1.76 |
| VEC89A-06 | 35 | 14.26 | 12.29 | 11.34 | 2.92 | 3.06 | 2.11 | 7.67 |
| | 66 | | | | | | | |
| | 100 | 8.30 | 7.52 | 7.64 | 1.96 | 2.29 | 1.80 | 4.33 |
| VEC89A-07 | 285 - 295 | 10.97 | 12.33 | 15.98 | 4.74 | 5.28 | 3.93 | 7.86 |
| | 332 | 10.08 | 11.66 | 16.47 | 6.72 | 5.93 | 4.08 | 5.14 |
| | 380 - 390 | 13.95 | 12.18 | 14.39 | 4.28 | 4.80 | 3.10 | 8.05 |
| VEC89A-18 | 50 | 17.18 | 15.34 | 17.79 | 5.35 | 6.05 | 4.38 | 9.03 |
| | 245 | 4.46 | 1.58 | 1.13 | 0.36 | 0.31 | 0.19 | 1.46 |
| | 260 | 13.77 | 13.77 | 17.61 | 5.01 | 5.95 | 3.91 | 8.45 |
| | 330 | 2.52 | 1.02 | 0.74 | 0.22 | 0.16 | 0.05 | 0.97 |
| | 360 | | | | | | | |
| | 375 - 380 | 1.03 | 0.57 | 0.48 | 0.14 | 0.12 | 0.13 | 0.41 |
| VEC89A-20 | 295 | 17.39 | 15.00 | 13.77 | 3.62 | 5.00 | 2.25 | 1.52 |
| | 400 | 0.85 | 0.51 | 0.40 | 0.13 | 0.08 | 0.11 | 0.52 |
| | 420 | 3.09 | 1.68 | 1.26 | 0.26 | 0.44 | 0.16 | 0.48 |
| VEC89A-21 | 50 - 55 | 15.36 | 14.13 | 15.85 | 5.01 | 7.23 | 4.85 | 8.87 |
| | 90 - 95 | 17.27 | 13.13 | 12.67 | 3.61 | 4.15 | 3.30 | 8.45 |
| | 300 - 305 | 16.18 | 13.32 | 11.96 | 3.44 | 3.87 | 3.29 | 6.73 |
| | 307 - 310 | 14.01 | 10.67 | 9.64 | 2.67 | 2.91 | 2.55 | 5.27 |
| VEC89A-23 | 127 | 3.45 | 1.02 | 0.79 | 0.17 | 0.31 | 0.17 | 2.55 |
| | 150 | 14.86 | 15.52 | 17.15 | 5.23 | 5.96 | 4.74 | 9.39 |
| | 180 | 1.97 | 0.99 | 0.82 | 0.23 | 0.25 | 0.18 | 0.75 |
| VEC89A-25 | 15 | | | | | | | |
| | 70 | | | | | | | |
| | 130 | | | | | | | |

| core | interval | weight | wt. sum | wt. loss | %sand | %silt | %clay | sand:mud |
|---|---|---|---|---|---|---|---|---|
| VEC89A-01 | 0 - 5 | 139.57 | 136.53 | 3.04 | 19.74 | 39.80 | 38.92 | 0.25 |
| | 573 - 580 | 148.42 | 146.41 | 2.01 | 27.26 | 29.60 | 42.19 | 0.38 |
| VEC89A-03 | 8 - 12 | 81.04 | 79.72 | 1.32 | 58.33 | 26.84 | 12.75 | 1.47 |
| | 12 - 15 | 40.41 | 39.96 | 0.45 | 87.66 | 9.56 | 1.21 | 8.14 |
| | 30 - 31 | 28.52 | 27.68 | 0.84 | 38.08 | 38.33 | 22.35 | 0.63 |
| | 35 - 40 | 90.35 | 88.59 | 1.76 | 44.37 | 38.99 | 13.68 | 0.84 |
| | 70 - 72 | 25.37 | 24.62 | 0.75 | 82.94 | 12.85 | 3.14 | 5.19 |
| | 75 - 80 | 67.50 | 66.46 | 1.04 | 65.41 | 26.98 | 5.36 | 2.02 |
| | 95 - 97 | 38.82 | 38.14 | 0.68 | 40.59 | 34.82 | 22.76 | 0.70 |
| | 110 | 47.87 | 47.23 | 0.64 | 92.61 | 115.62 | 1.25 | 0.79 |
| | 116 | 23.21 | 22.57 | 0.64 | 16.08 | 160.64 | 38.52 | 0.08 |
| | 125 | 72.03 | 71.44 | 0.59 | 97.44 | | | 38.04 |
| | 145 | 71.82 | 71.26 | 0.56 | 96.56 | | | 28.09 |
| | 170 | 56.33 | 55.35 | 0.98 | 89.97 | 178.10 | 1.54 | 0.50 |
| | 173 | 50.05 | 49.55 | 0.50 | 59.01 | 200.09 | 12.46 | 0.28 |
| | 210 | 76.68 | 76.19 | 0.49 | 98.23 | | | 55.44 |
| | 220 | 22.61 | 22.06 | 0.55 | 57.98 | 246.77 | 14.41 | 0.22 |
| VEC89A-06 | 35 | 25.65 | 25.71 | -0.06 | 32.09 | 75.40 | 27.10 | 0.31 |
| | 66 | 12.36 | 12.55 | -0.19 | 86.85 | | | 6.61 |
| | 100 | 39.13 | 38.69 | 0.44 | 59.11 | 122.28 | 18.02 | 0.42 |
| VEC89A-07 | 285 - 295 | 144.60 | 141.97 | 2.63 | 32.27 | 29.12 | 37.79 | 0.48 |
| | 332 | 71.58 | 70.45 | 1.13 | 34.14 | 359.53 | 38.33 | 0.09 |
| | 380 - 390 | 139.54 | 136.82 | 2.72 | 26.18 | 37.57 | 34.62 | 0.36 |
| VEC89A-18 | 50 | 31.88 | 31.37 | 0.51 | 12.37 | 92.94 | 42.59 | 0.09 |
| | 245 | 100.27 | 99.77 | 0.50 | 76.04 | 264.09 | 3.45 | 0.28 |
| | 260 | 29.12 | 28.41 | 0.71 | 21.75 | 295.92 | 40.92 | 0.06 |
| | 330 | 38.54 | 58.01 | -19.47 | 86.28 | 340.65 | 2.15 | 0.25 |
| | 360 | 69.60 | 69.43 | 0.17 | 96.08 | | | 24.53 |
| | 375 - 380 | 123.38 | 123.07 | 0.31 | 94.52 | 3.78 | 1.27 | 18.73 |
| VEC89A-20 | 295 | 42.53 | 42.32 | 0.21 | 27.53 | 340.66 | 26.16 | 0.08 |
| | 400 | 71.12 | 71.45 | -0.33 | 95.05 | 403.29 | 1.24 | 0.23 |
| | 420 | 70.53 | 70.32 | 0.21 | 85.35 | 431.18 | 2.61 | 0.20 |
| VEC89A-21 | 50 - 55 | 21.99 | 21.72 | 0.27 | 17.86 | 39.67 | 41.81 | 0.22 |
| | 90 - 95 | 41.37 | 41.29 | 0.08 | 23.23 | 43.45 | 32.17 | 0.31 |
| | 300 - 305 | 23.46 | 23.28 | 0.18 | 28.39 | 41.68 | 29.29 | 0.40 |
| | 307 - 310 | 31.06 | 31.04 | 0.02 | 39.37 | 36.38 | 23.04 | 0.66 |
| VEC89A-23 | 127 | 74.55 | 74.4 | 0.15 | 79.09 | 142.33 | 3.99 | 0.54 |
| | 150 | 52.99 | 51.86 | 1.13 | 18.34 | 188.79 | 42.46 | 0.08 |
| | 180 | 78.04 | 77.85 | 0.19 | 89.67 | 187.49 | 2.22 | 0.47 |
| VEC89A-25 | 15 | 60.41 | 60.56 | -0.15 | 98.41 | | | 62.08 |
| | 70 | 66.19 | 66.5 | -0.31 | 99.52 | | | 206.81 |
| | 130 | 48.31 | 48.52 | -0.21 | 99.48 | | | 193.08 |

| core | interval | mean | std. dev. | comments (2) | Facies (3) |
|---|---|---|---|---|---|
| VEC89A-01 | 0 - 5 | 7.20 | 2.831603 | w/m | 1 |
| | 573 - 580 | 7.16 | 3.078098 | w/s | 1 |
| VEC89A-03 | 8 - 12 | 4.85 | 2.583094 | w/m | 4a |
| | 12 - 15 | 3.38 | 1.153142 | w/m | 4a |
| | 30 - 31 | 5.83 | 2.672164 | w | 4a |
| | 35 - 40 | 5.12 | 2.28005 | w/m | 4a |
| | 70 - 72 | 3.63 | 1.583072 | w/m | 4a |
| | 75 - 80 | 4.13 | 1.7933 | w | 4a |
| | 95 - 97 | 5.67 | 2.743211 | w/m | 4a |
| | 110 | 2.70 | 1.427247 | w | 4a |
| | 116 | 7.15 | 2.528486 | | 4a |
| | 125 | 2.36 | 0.666077 | w/m | 4a |
| | 145 | 2.33 | 0.682325 | w | 4a |
| | 170 | 2.71 | 1.679114 | w | 4a |
| | 173 | 4.70 | 2.45723 | w | 4a |
| | 210 | 2.05 | 0.777503 | w | 4c |
| | 220 | 4.65 | 2.755001 | w/m | 4a |
| VEC89A-06 | 35 | 6.37 | 2.859925 | | 1/2 |
| | 66 | 2.79 | 0.599368 | | 4b |
| | 100 | 4.91 | 2.993127 | w | 2/3 |
| VEC89A-07 | 285 - 295 | 6.82 | 3.002436 | | 2 |
| | 332 | 6.76 | 2.917045 | | 2 |
| | 380 - 390 | 6.77 | 2.856992 | | 1 |
| VEC89A-18 | 50 | 7.49 | 2.619772 | | 1 |
| | 245 | 3.71 | 1.78139 | w/m | 4b |
| | 260 | 7.17 | 2.849059 | m | 1 |
| | 330 | 3.17 | 1.613214 | w/m | 4 |
| | 360 | 2.45 | 0.743855 | w/m | 4b?/4a |
| | 375 - 380 | 2.89 | 1.282698 | w/m | 4b?/4a |
| VEC89A-20 | 295 | 6.34 | 2.426548 | s | 2 |
| | 400 | 3.09 | 1.144595 | | 4 |
| | 420 | 3.49 | 1.49913 | w/m | 4 |
| VEC89A-21 | 50 - 55 | 7.40 | 2.826851 | | 1 |
| | 90 - 95 | 6.82 | 2.819692 | s | 1 |
| | 300 - 305 | 6.52 | 2.890193 | s | 4b |
| | 307 - 310 | 5.78 | 2.954339 | | 2 |
| VEC89A-23 | 127 | 3.69 | 1.961962 | w/m/s | 4b |
| | 150 | 7.43 | 2.851143 | | 1 |
| | 180 | 3.11 | 1.545865 | w/m | 4b/4c |
| VEC89A-25 | 15 | 2.12 | 0.656513 | m | 4c |
| | 70 | 2.04 | 0.657356 | m | 4c |
| | 130 | 2.05 | 0.634991 | m/s | 4c |

| core | interval | -1.0 phi | -1.0 - 1.0 | .0 - 2.0 | .0 - 3.0 | 3.0 - 4.0 | 4.0 - 5.0 | 5.0 - 6.0 |
|---|---|---|---|---|---|---|---|---|
| VEC89A-39 | 17 | 0.02 | 0.09 | 0.46 | 2.70 | 47.54 | 7.33 | 2.75 |
| | 32 | 0.20 | 2.27 | 10.93 | 32.89 | 27.79 | 3.89 | 1.48 |
| | 70 | | 0.14 | 15.95 | 54.69 | 23.72 | 1.20 | 0.39 |
| | 100 | | 0.27 | 21.41 | 57.23 | 19.10 | | |
| | 125 | 1.06 | 3.12 | 14.56 | 43.24 | 22.18 | 1.88 | 0.73 |
| | basal sand | 1.54 | 7.71 | 12.29 | 37.01 | 34.72 | 1.47 | 0.41 |
| VEC89A-40 | 20 | | | 0.23 | 4.25 | 26.63 | 9.64 | 4.62 |
| | 25 | 12.80 | 25.90 | 11.35 | 23.44 | 19.50 | | |
| | 30 | | 2.65 | 3.66 | 7.04 | 24.21 | 4.62 | 2.68 |
| VEC89A-41 | 20 - 23 | | 0.19 | 13.25 | 24.91 | 29.19 | 3.08 | 1.59 |
| | 60 - 62 | 0.01 | 0.38 | 27.71 | 59.84 | 11.39 | | |
| | 90 | 0.01 | 0.51 | 23.12 | 47.09 | 25.95 | 1.37 | 0.31 |
| | 120 | | 0.16 | 22.85 | 32.57 | 18.95 | 3.85 | 1.76 |
| | 140 | | 0.32 | 29.09 | 51.64 | 17.02 | | |
| VEC89A-42 | 0 - 5 | | 0.11 | 2.32 | 16.21 | 41.92 | 6.55 | 2.68 |
| | 44 - 46 | | 0.19 | 10.20 | 50.43 | 31.89 | 3.20 | 0.71 |
| | 58 - 62 | | 0.29 | 9.00 | 35.67 | 29.29 | 3.48 | 1.57 |
| | 28 - 30 | | 0.63 | 1.61 | 17.02 | 50.69 | 7.99 | 2.73 |
| VEC89A-44 | 15 - 20 | | 0.42 | 1.42 | 8.81 | 34.09 | 4.03 | 2.05 |
| | 25 - 28 | | 0.34 | 14.14 | 32.79 | 26.47 | 4.07 | 1.47 |
| | 28 - 32 | | 0.64 | 30.46 | 50.93 | 15.06 | 0.72 | 0.23 |
| | 50 | | 0.54 | 31.44 | 52.34 | 14.62 | | |
| | 100 | | 0.45 | 29.47 | 55.61 | 13.60 | | |
| | 150 | 0.09 | 1.14 | 44.91 | 44.80 | 8.43 | | |
| | 200 | | 0.18 | 18.09 | 58.99 | 20.64 | 0.60 | 0.19 |
| | 165 | | 0.44 | 6.66 | 30.94 | 27.87 | 3.65 | 1.74 |
| | 173 | | 0.08 | 4.30 | 23.86 | 31.05 | 6.51 | 3.05 |
| | 254 | 0.28 | 2.27 | 9.98 | 21.06 | 40.24 | 6.54 | 2.49 |
| | 259 | 0.10 | 1.34 | 13.35 | 38.64 | 38.12 | 3.29 | 0.82 |
| | 262 - 265 | | 0.07 | 1.26 | 14.30 | 35.83 | 4.76 | 2.28 |
| VEC89A-45 | 10 - 15 | | 0.16 | 3.70 | 36.20 | 52.72 | 2.51 | 0.61 |
| | 45 - 50 | 3.30 | 0.67 | 5.08 | 24.44 | 21.84 | 3.53 | 2.28 |
| | 60 - 65 | 0.04 | 1.62 | 4.55 | 55.40 | 28.15 | 1.94 | 0.80 |
| | 90 - 95 | 0.03 | 1.40 | 13.36 | 39.93 | 32.56 | 3.36 | 0.99 |
| | 103 - 105 | | 4.41 | 11.91 | 17.80 | 27.83 | 2.82 | 1.41 |
| | 140 | | 0.15 | 15.56 | 52.41 | 28.93 | | |
| | 144 | | 7.75 | 24.68 | 31.53 | 14.77 | | |
| VEC89A-46 | 20 | | | 1.49 | 32.51 | 41.36 | 5.22 | 1.95 |
| | 35A | | | 1.32 | 58.41 | 25.51 | 2.83 | 1.06 |
| | 35B | | | 0.72 | 44.17 | 28.04 | 3.41 | 1.46 |
| | 60 | | 0.24 | 6.54 | 62.15 | 26.46 | | |
| | 85 | | 1.22 | 14.66 | 39.98 | 30.08 | 3.44 | 1.14 |
| | 95 - 97 | | | 3.59 | 24.09 | 25.85 | 6.74 | 2.97 |

| core | interval | 6.0 - 7.0 | 7.0 - 8.0 | 8.0 - 9.0 | 9.0 - 10.0 | 0.0 - 11.0 | 11.0 - 12.0 | >12.0 |
|---|---|---|---|---|---|---|---|---|
| VEC89A-39 | 17 | 9.30 | 7.77 | 8.31 | 2.36 | 2.66 | 1.38 | 6.59 |
| | 32 | 4.92 | 4.04 | 4.25 | 1.06 | 1.43 | 0.49 | 3.94 |
| | 70 | 1.21 | 0.84 | 0.77 | 0.16 | 0.23 | 0.11 | 0.33 |
| | 100 | | | | | | | |
| | 125 | 3.06 | 2.79 | 2.58 | 0.62 | 0.87 | 0.67 | 2.22 |
| | basal sand | 1.24 | 0.91 | 0.81 | 0.22 | 0.27 | 0.13 | 0.94 |
| VEC89A-40 | 20 | 17.91 | 14.12 | 11.57 | 2.89 | 3.86 | 1.58 | 1.86 |
| | 25 | | | | | | | |
| | 30 | 11.11 | 12.36 | 14.23 | 3.87 | 4.37 | 2.74 | 5.99 |
| VEC89A-41 | 20 - 23 | 6.59 | 6.39 | 6.98 | 1.79 | 2.14 | 1.72 | 1.56 |
| | 60 - 62 | | | | | | | |
| | 90 | 0.55 | 0.25 | 0.19 | 0.04 | 0.06 | 0.08 | 0.12 |
| | 120 | 6.55 | 5.20 | 4.05 | 0.99 | 0.99 | 0.64 | 0.76 |
| | 140 | | | | | | | |
| VEC89A-42 | 0 - 5 | 8.72 | 6.31 | 6.39 | 1.81 | 2.21 | 1.54 | 2.01 |
| | 44 - 46 | 1.12 | 0.51 | 0.42 | 0.12 | 0.13 | 0.04 | 0.23 |
| | 58 - 62 | 5.53 | 4.32 | 4.58 | 1.29 | 1.52 | 1.00 | 1.60 |
| | 28 - 30 | 6.55 | 3.55 | 3.37 | 0.93 | 1.14 | 0.93 | 0.87 |
| VEC89A-44 | 15 - 20 | 9.06 | 9.34 | 12.27 | 3.54 | 4.15 | 3.43 | 6.85 |
| | 25 - 28 | 5.04 | 3.91 | 4.41 | 1.26 | 1.47 | 1.08 | 3.02 |
| | 28 - 32 | 0.60 | 0.36 | 0.34 | 0.09 | 0.13 | 0.07 | 0.17 |
| | 50 | | | | | | | |
| | 100 | | | | | | | |
| | 150 | | | | | | | |
| | 200 | 0.51 | 0.28 | 0.20 | 0.03 | 0.06 | 0.02 | 0.09 |
| | 165 | 6.72 | 6.14 | 6.48 | 1.64 | 1.87 | 1.64 | 3.72 |
| | 173 | 9.69 | 6.47 | 5.86 | 1.59 | 1.75 | 1.59 | 3.70 |
| | 254 | 5.99 | 2.96 | 2.88 | 0.79 | 0.86 | 0.84 | 2.17 |
| | 259 | 1.48 | 0.64 | 0.50 | 0.14 | 0.13 | 0.12 | 0.78 |
| | 262 - 265 | 9.03 | 7.77 | 9.66 | 2.67 | 3.11 | 2.28 | 6.26 |
| VEC89A-45 | 10 - 15 | 1.44 | 0.88 | 0.77 | 0.14 | 0.14 | 0.09 | 0.12 |
| | 45 - 50 | 8.89 | 8.26 | 9.34 | 2.77 | 3.17 | 1.88 | 4.07 |
| | 60 - 65 | 2.32 | 1.53 | 1.58 | 0.38 | 0.36 | 0.28 | 0.94 |
| | 90 - 95 | 2.40 | 1.49 | 1.51 | 0.41 | 0.48 | 0.38 | 1.18 |
| | 103 - 105 | 6.55 | 7.73 | 7.76 | 2.25 | 2.89 | 2.13 | 3.65 |
| | 140 | | | | | | | |
| | 144 | | | | | | | |
| VEC89A-46 | 20 | 5.96 | 3.60 | 3.13 | 0.74 | 1.11 | 0.76 | 1.33 |
| | 35A | 3.53 | 2.42 | 2.11 | 0.52 | 0.81 | 0.52 | 0.52 |
| | 35B | 5.63 | 4.90 | 4.82 | 1.33 | 1.84 | 1.35 | 1.60 |
| | 60 | | | | | | | |
| | 85 | 3.26 | 1.99 | 1.76 | 0.45 | 0.49 | 0.45 | 0.51 |
| | 95 - 97 | 12.13 | 8.50 | 7.06 | 1.77 | 2.32 | 2.04 | 1.72 |

| core | interval | weight | wt. sum | wt. loss | %sand | %silt | %clay | sand:mud |
|---|---|---|---|---|---|---|---|---|
| VEC89A-39 | 17 | 53.91 | 58.45 | -4.54 | 50.82 | 44.15 | 21.30 | 0.78 |
| | 32 | 54.28 | 53.72 | 0.56 | 74.09 | 46.33 | 11.17 | 1.29 |
| | 70 | 73.02 | 71.93 | 1.09 | 94.49 | 73.64 | 1.60 | 1.26 |
| | 100 | 97.71 | 97.64 | 0.07 | 98.00 | | | 49.07 |
| | 125 | 65.04 | 60.29 | 4.75 | 84.16 | 133.46 | 6.95 | 0.60 |
| | basal sand | 169.35 | 167.74 | 1.61 | 93.28 | 4.03 | 2.37 | 14.57 |
| VEC89A-40 | 20 | 27.32 | 26.36 | 0.96 | 31.11 | 66.29 | 21.76 | 0.35 |
| | 25 | | 33.74 | -33.74 | 93.01 | | | 13.30 |
| | 30 | 25.81 | 24.87 | 0.94 | 37.56 | 60.77 | 31.20 | 0.41 |
| VEC89A-41 | 20 - 23 | 25.81 | 24.87 | 0.94 | 67.54 | 17.65 | 14.19 | 2.12 |
| | 60 - 62 | 84.89 | 84.44 | 0.45 | 99.34 | | | 149.79 |
| | 90 | 93.01 | 92.77 | 0.24 | 96.68 | 92.48 | 0.49 | 1.04 |
| | 120 | 58.09 | 57.69 | 0.40 | 74.52 | 137.35 | 7.44 | 0.51 |
| | 140 | 85.23 | 85.12 | 0.11 | 98.07 | | | 50.90 |
| VEC89A-42 | 0 - 5 | 97.75 | 96.79 | 0.96 | 60.56 | 24.25 | 13.96 | 1.58 |
| | 44 - 46 | 43.11 | 42.83 | 0.28 | 92.72 | 5.54 | 0.95 | 14.28 |
| | 58 - 62 | 79.59 | 78.74 | 0.85 | 74.26 | 14.91 | 9.99 | 2.98 |
| | 28 - 30 | 92.92 | 72.87 | 20.05 | 69.95 | 20.83 | 7.24 | 2.49 |
| VEC89A-44 | 15 - 20 | 96.53 | 93.919 | 2.61 | 44.73 | 24.49 | 30.23 | 0.82 |
| | 25 - 28 | 121.20 | 119.77 | 1.43 | 73.74 | 14.49 | 11.24 | 2.87 |
| | 28 - 32 | 99.11 | 99.04 | 0.07 | 97.09 | 1.91 | 0.81 | 35.71 |
| | 50 | 102.77 | 102.41 | 0.36 | 98.94 | | | 92.95 |
| | 100 | 121.55 | 121.43 | 0.12 | 99.14 | | | 114.65 |
| | 150 | 95.51 | 95.02 | 0.49 | 99.37 | | | 157.37 |
| | 200 | 153.68 | 152.71 | 0.97 | 97.90 | 201.57 | 0.40 | 0.48 |
| | 165 | 14.05 | 13.67 | 0.38 | 65.91 | 183.24 | 15.34 | 0.33 |
| | 173 | 85.60 | 84.44 | 1.16 | 59.30 | 198.72 | 14.49 | 0.28 |
| | 254 | 91.71 | 90.75 | 0.96 | 73.83 | 271.98 | 7.54 | 0.26 |
| | 259 | 70.26 | 69.36 | 0.90 | 91.55 | 265.23 | 1.66 | 0.34 |
| | 262 - 265 | 81.43 | 85.75 | -4.32 | 51.45 | 23.84 | 23.98 | 1.08 |
| VEC89A-45 | 10 - 15 | 108.38 | 107.32 | 1.06 | 92.78 | 5.45 | 1.26 | 13.83 |
| | 45 - 50 | 67.41 | 66.15 | 1.26 | 55.33 | 22.96 | 21.22 | 1.25 |
| | 60 - 65 | 85.76 | 85.35 | 0.41 | 89.75 | 6.58 | 3.54 | 8.87 |
| | 90 - 95 | 96.68 | 95.591 | 1.09 | 87.28 | 8.24 | 3.97 | 7.15 |
| | 103 - 105 | 60.40 | 59.44 | 0.96 | 61.94 | 18.49 | 18.69 | 1.67 |
| | 140 | 122.27 | 121.36 | 0.91 | 97.05 | | | 32.90 |
| | 144 | 5.81 | 5.55 | 0.26 | 78.74 | | | 3.70 |
| VEC89A-46 | 20 | 59.48 | 59.09 | 0.39 | 75.36 | 36.73 | 7.07 | 1.72 |
| | 35A | 62.33 | 61.94 | 0.39 | 85.24 | 9.84 | 4.47 | 5.96 |
| | 35B | 55.88 | 55.67 | 0.21 | 72.93 | 15.40 | 10.94 | 2.77 |
| | 60 | 62.23 | 62.09 | 0.14 | 95.39 | | | 20.71 |
| | 85 | 65.88 | 65.35 | 0.53 | 85.95 | 94.83 | 3.65 | 0.87 |
| | 95 - 97 | 28.45 | 28.43 | 0.02 | 53.53 | 30.34 | 14.92 | 1.18 |

| core | interval | mean | std. dev. | comments (2) | Facies (3) |
|---|---|---|---|---|---|
| VEC89A-39 | 17 | 5.60 | 2.868685 | w | 2? |
| | 32 | 4.00 | 2.769554 | w | 3 |
| | 70 | 2.81 | 1.308179 | m | 4a |
| | 100 | 2.42 | 0.650528 | m | 4a |
| | 125 | 3.32 | 2.433051 | w | 4a |
| | basal sand | 2.79 | 1.802458 | w/m | 4a |
| VEC89A-40 | 20 | 6.03 | 2.437329 | fv/s/w | 1/2 |
| | 25 | 1.25 | 1.653563 | s/w | 5 |
| | 30 | 6.18 | 3.170472 | fv/s/w | 1/2 |
| VEC89A-41 | 20 - 23 | 4.36 | 2.74542 | w/m/s | 3 |
| | 60 - 62 | 2.31 | 0.621841 | w/m/s | 4a/4c |
| | 90 | 2.62 | 1.026771 | w/m | 4a/4c |
| | 120 | 3.62 | 2.377704 | m | 2? |
| | 140 | 2.32 | 0.682732 | w/m | 4a |
| VEC89A-42 | 0 - 5 | 4.76 | 2.540613 | m | 1? |
| | 44 - 46 | 2.92 | 1.138993 | m | 4 |
| | 58 - 62 | 3.97 | 2.466401 | w/m | 4? |
| | 28 - 30 | 4.14 | 2.048288 | w/m | 2? |
| VEC89A-44 | 15 - 20 | 6.08 | 3.151788 | w/s | 1 |
| | 25 - 28 | 3.99 | 2.695136 | | 3 |
| | 28 - 32 | 2.45 | 1.099495 | | 4c |
| | 50 | 2.29 | 0.67927 | s | 4c |
| | 100 | 2.31 | 0.655916 | | 4c |
| | 150 | 2.09 | 0.679075 | s | 4c |
| | 200 | 2.60 | 0.90247 | m/s | 4a/4c |
| | 165 | 4.56 | 2.887279 | | 2? |
| | 173 | 4.80 | 2.770794 | | 2? |
| | 254 | 3.90 | 2.382257 | w | 4a? |
| | 259 | 3.02 | 1.462398 | w | 4a |
| | 262 - 265 | 5.59 | 3.056212 | | 1/2? |
| VEC89A-45 | 10 - 15 | 3.23 | 1.119121 | | 4a |
| | 45 - 50 | 5.00 | 3.267195 | w | 4a/3? |
| | 60 - 65 | 3.19 | 1.732912 | | 4a |
| | 90 - 95 | 3.22 | 1.880788 | | 4a |
| | 103 - 105 | 4.69 | 3.178645 | | 3? |
| | 140 | 2.56 | 0.665269 | | 4a? |
| | 144 | 1.68 | 0.964963 | | 4a? |
| VEC89A-46 | 20 | 3.99 | 2.124991 | | 3 |
| | 35A | 3.41 | 1.807417 | w/m | 4b |
| | 35B | 4.15 | 2.478245 | m | 3 |
| | 60 | 2.58 | 0.566359 | m | 4a |
| | 85 | 3.21 | 1.815041 | w/m | 4a |
| | 95 - 97 | 4.92 | 2.667399 | w/m | 1 |

| core | interval | -1.0 phi | -1.0 - 1.0 | .0 - 2.0 | .0 - 3.0 | 3.0 - 4.0 | 4.0 - 5.0 | 5.0 - 6.0 |
|---|---|---|---|---|---|---|---|---|
| PAR91A-14 | 18 - 20 | | 0.12 | 1.27 | 2.93 | 25.05 | 8.22 | 4.35 |
| | 78 - 80 | | 0.05 | 2.15 | 1.65 | 15.54 | 7.82 | 4.19 |
| | 175 - 177 | 0.16 | 0.67 | 13.47 | 5.67 | 25.48 | 7.90 | 3.60 |
| | 245 - 247 | | 0.14 | 2.59 | 4.91 | 15.88 | 6.36 | 3.37 |
| | 300 - 302 | | 0.11 | 4.53 | 6.47 | 15.31 | 5.27 | 2.74 |
| | 390 - 392 | | 0.16 | 5.74 | 10.16 | 27.88 | 4.63 | 2.67 |
| PAR91A-26 | 15 - 17 | | | 1.17 | 1.86 | 29.56 | 5.58 | 2.73 |
| | 70 - 72 | | | 0.43 | 2.21 | 28.26 | 3.87 | 2.27 |
| | 150 - 152 | | | 0.31 | 1.87 | 33.69 | 5.17 | 2.68 |
| | 198 - 200 | | 0.42 | 0.37 | 4.68 | 37.15 | 3.18 | 1.64 |
| | 290 - 292 | | 0.14 | 0.35 | 3.50 | 38.74 | 4.06 | 2.27 |
| | 360 - 362 | | | 2.12 | 4.24 | 30.85 | 3.38 | 1.81 |
| | 420 - 422 | | 0.14 | 0.32 | 4.09 | 38.45 | 4.29 | 2.12 |
| TUL92A-79 | 30 - 32 | 0.12 | 1.75 | 1.05 | 6.59 | 47.55 | 2.55 | 1.48 |
| | 59 - 61 | 0.53 | 1.59 | 2.22 | 8.80 | 41.94 | 3.54 | 1.86 |
| | 130 - 132 | | 0.19 | 0.95 | 5.70 | 36.69 | 5.07 | 2.74 |
| | 175 - 177 | | 0.68 | 33.05 | 53.77 | 10.78 | | |
| | 198 - 200 | | 0.04 | 8.61 | 33.52 | 26.13 | 3.85 | 1.86 |
| | 220 - 222 | | 0.91 | 19.95 | 55.60 | 19.53 | | |
| | 250 - 252 | | | 0.67 | 6.08 | 35.28 | 6.33 | 2.77 |
| | 335 - 337 | | | 0.64 | 13.77 | 50.69 | 3.25 | 1.36 |
| | 375 - 377 | | 0.1 | 0.24 | 21.35 | 33.62 | 4.81 | 2.22 |
| | 425 - 427 | | 0.55 | 5.25 | 45.28 | 44.49 | | |
| TUL92A-112 | 10 - 12 | | | 1.21 | 8.19 | 58.15 | 6.78 | 2.52 |
| TUL92A-162 | 15 - 17 | | | 0.38 | 27.69 | 40.26 | 3.88 | 1.72 |
| | 45 - 47 | | 0.22 | 0.66 | 16.76 | 44.47 | 5.18 | 2.28 |
| | 80 - 82 | 0.02 | 0.03 | 1.24 | 10.05 | 30.96 | 5.83 | 2.87 |
| | 135 - 137 | | | 2.16 | 12.74 | 35.27 | 5.31 | 2.78 |
| | 170 - 172 | | 0.09 | 2.53 | 14.57 | 36.18 | 7.13 | 3.12 |
| | 185 | | 0.29 | 15.78 | 25.47 | 34.87 | 3.53 | 1.46 |
| | 213 - 215 | | | 12.13 | 30.50 | 26.51 | 4.28 | 1.98 |
| TUL92A-163 | 18 - 20 | | 0.06 | 7.29 | 59.34 | 17.37 | 1.41 | 0.74 |
| | 43 - 45 | | 0.09 | 5.01 | 61.79 | 24.52 | 1.30 | 0.55 |
| | 65 - 67 | | 0.07 | 6.43 | 50.25 | 23.25 | 1.79 | 0.92 |
| | 71 - 73 | | 0.08 | 4.02 | 46.41 | 15.61 | 2.55 | 1.58 |
| | 92 - 94 | | 0.20 | 2.49 | 36.70 | 44.95 | 2.06 | 0.92 |
| | 133 - 135 | | 0.10 | 1.02 | 9.50 | 29.58 | 6.04 | 3.25 |
| | 163 - 165 | | 0.03 | 6.65 | 48.78 | 30.69 | 1.80 | 0.77 |
| | 197 - 199 | | 1.10 | 12.85 | 31.89 | 34.56 | 3.42 | 1.38 |

| core | interval | 6.0 - 7.0 | 7.0 - 8.0 | 8.0 - 9.0 | 9.0 - 10.0 | 0.0 - 11.0 | 11.0 - 12.0 | >12.0 |
|---|---|---|---|---|---|---|---|---|
| PAR91A-14 | 18 - 20 | 18.17 | 12.43 | 10.84 | 3.52 | 3.87 | 3.45 | 3.66 |
| | 78 - 80 | 18.30 | 15.64 | 13.71 | 4.43 | 5.89 | 6.05 | 3.87 |
| | 175 - 177 | 14.39 | 11.66 | 8.88 | 2.07 | 2.02 | 1.69 | 1.31 |
| | 245 - 247 | 14.14 | 13.54 | 14.51 | 4.56 | 6.66 | 6.06 | 4.11 |
| | 300 - 302 | 14.86 | 14.86 | 14.65 | 4.33 | 6.28 | 4.33 | 4.40 |
| | 390 - 392 | 12.59 | 10.74 | 9.76 | 2.94 | 3.98 | 3.60 | 3.43 |
| PAR91A-26 | 15 - 17 | 10.77 | 10.71 | 12.72 | 4.02 | 5.71 | 3.76 | 7.85 |
| | 70 - 72 | 10.87 | 10.61 | 12.74 | 4.34 | 6.40 | 5.00 | 9.94 |
| | 150 - 152 | 11.46 | 10.34 | 11.27 | 3.55 | 5.11 | 4.36 | 8.28 |
| | 198 - 200 | 8.21 | 9.64 | 11.77 | 3.61 | 5.20 | 3.34 | 7.67 |
| | 290 - 292 | 9.83 | 8.84 | 9.61 | 3.06 | 4.50 | 3.67 | 8.67 |
| | 360 - 362 | 8.34 | 9.61 | 13.47 | 4.23 | 6.22 | 4.05 | 8.82 |
| | 420 - 422 | 8.41 | 8.52 | 11.24 | 3.52 | 5.27 | 3.37 | 7.38 |
| TUL92A-79 | 30 - 32 | 6.75 | 7.12 | 8.60 | 2.55 | 3.33 | 2.59 | 5.31 |
| | 59 - 61 | 7.26 | 7.22 | 8.99 | 2.64 | 3.37 | 2.64 | 5.44 |
| | 130 - 132 | 11.01 | 9.38 | 10.13 | 3.61 | 5.07 | 3.38 | 7.33 |
| | 175 - 177 | | | | | | | |
| | 198 - 200 | 6.57 | 4.93 | 4.56 | 1.33 | 2.04 | 1.40 | 3.81 |
| | 220 - 222 | | | | | | | |
| | 250 - 252 | 10.97 | 9.39 | 10.01 | 3.00 | 3.84 | 3.28 | 6.78 |
| | 335 - 337 | 5.51 | 5.93 | 6.98 | 2.09 | 2.41 | 1.85 | 5.06 |
| | 375 - 377 | 8.08 | 6.90 | 7.53 | 2.18 | 2.59 | 2.01 | 5.02 |
| | 425 - 427 | | | | | | | |
| TUL92A-112 | 10 - 12 | 7.70 | 4.59 | 3.74 | 1.08 | 1.31 | 1.02 | 3.01 |
| TUL92A-162 | 15 - 17 | 6.53 | 5.11 | 4.40 | 1.14 | 1.79 | 1.11 | 4.37 |
| | 45 - 47 | 7.60 | 5.51 | 4.70 | 1.21 | 2.02 | 0.99 | 6.28 |
| | 80 - 82 | 10.45 | 8.07 | 6.86 | 1.84 | 2.69 | 1.44 | 4.17 |
| | 135 - 137 | 11.84 | 8.63 | 7.46 | 1.90 | 2.83 | 1.46 | 5.99 |
| | 170 - 172 | 10.26 | 6.95 | 5.78 | 1.77 | 3.22 | 1.40 | 5.87 |
| | 185 | 5.03 | 3.62 | 3.09 | 0.84 | 1.32 | 0.90 | 2.74 |
| | 213 - 215 | 7.10 | 4.79 | 3.95 | 1.08 | 1.59 | 0.96 | 3.95 |
| TUL92A-163 | 18 - 20 | 3.07 | 2.80 | 2.95 | 0.83 | 0.99 | 1.07 | 0.76 |
| | 43 - 45 | 1.88 | 1.39 | 1.14 | 0.33 | 0.39 | 0.33 | 0.53 |
| | 65 - 67 | 3.86 | 3.27 | 2.86 | 0.87 | 1.28 | 1.05 | 2.65 |
| | 71 - 73 | 7.72 | 7.08 | 5.56 | 1.55 | 2.17 | 1.94 | 1.65 |
| | 92 - 94 | 3.29 | 2.61 | 2.28 | 0.70 | 0.83 | 0.73 | 0.98 |
| | 133 - 135 | 13.87 | 11.09 | 9.58 | 2.96 | 3.37 | 3.19 | 3.66 |
| | 163 - 165 | 2.74 | 2.11 | 1.78 | 0.48 | 0.73 | 0.40 | 1.76 |
| | 197 - 199 | 4.30 | 2.66 | 2.38 | 0.59 | 0.96 | 0.71 | 2.56 |

| core | interval | weight | wt. sum | wt. loss | %sand | %silt | %clay | sand:mud |
|---|---|---|---|---|---|---|---|---|
| PAR91A-14 | 18 - 20 | | 25.95 | -25.95 | 29.37 | 43.17 | 25.34 | 0.43 |
| | 78 - 80 | | 21.88 | -21.88 | 19.39 | 45.95 | 33.95 | 0.24 |
| | 175 - 177 | | 31.4 | -31.40 | 45.45 | 37.55 | 15.97 | 0.85 |
| | 245 - 247 | | 21.6 | -21.60 | 23.52 | 37.41 | 35.90 | 0.32 |
| | 300 - 302 | | 27.37 | -27.37 | 26.42 | 37.73 | 33.99 | 0.37 |
| | 390 - 392 | | 31.2 | -31.20 | 43.94 | 30.63 | 23.71 | 0.81 |
| PAR91A-26 | 15 - 17 | | 21.45 | -21.45 | 32.59 | 29.79 | 34.06 | 0.51 |
| | 70 - 72 | | 16.31 | -16.31 | 30.90 | 27.62 | 38.42 | 0.47 |
| | 150 - 152 | | 16.62 | -16.62 | 35.87 | 29.65 | 32.57 | 0.58 |
| | 198 - 200 | | 21.37 | -21.37 | 42.62 | 22.67 | 31.59 | 0.79 |
| | 290 - 292 | | 28.29 | -28.29 | 42.73 | 25.00 | 29.51 | 0.78 |
| | 360 - 362 | | 21.72 | -21.72 | 37.21 | 23.14 | 36.79 | 0.62 |
| | 420 - 422 | | 22.03 | -22.03 | 43.00 | 23.34 | 30.78 | 0.79 |
| TUL92A-79 | 30 - 32 | | 17.16 | -17.16 | 57.06 | 17.90 | 22.38 | 1.42 |
| | 59 - 61 | | 18.86 | -18.86 | 55.08 | 19.88 | 23.08 | 1.28 |
| | 130 - 132 | | 15.78 | -15.78 | 43.53 | 28.20 | 29.52 | 0.75 |
| | 175 - 177 | | 35.43 | -35.43 | 98.28 | | | 57.14 |
| | 198 - 200 | | 27.06 | -27.06 | 68.30 | 17.21 | 13.14 | 2.25 |
| | 220 - 222 | | 30.72 | -30.72 | 95.99 | | | 23.94 |
| | 250 - 252 | | 16.44 | -16.44 | 42.03 | 29.46 | 26.91 | 0.75 |
| | 335 - 337 | | 20.26 | -20.26 | 65.10 | 16.05 | 18.39 | 1.89 |
| | 375 - 377 | | 20.7 | -20.70 | 55.31 | 22.01 | 19.33 | 1.34 |
| | 425 - 427 | | 25.51 | -25.51 | 95.57 | | | 21.57 |
| TUL92A-112 | 10 - 12 | | 24.78 | -24.78 | 67.55 | 21.59 | 10.16 | 2.13 |
| TUL92A-162 | 15 - 17 | | 47.27 | -47.27 | 68.33 | 17.24 | 12.81 | 2.27 |
| | 45 - 47 | | 54.6 | -54.60 | 62.11 | 20.57 | 15.20 | 1.74 |
| | 80 - 82 | | 59.08 | -59.08 | 42.30 | 27.22 | 17.00 | 0.96 |
| | 135 - 137 | | 48.51 | -48.51 | 50.17 | 28.56 | 19.64 | 1.04 |
| | 170 - 172 | | 42.62 | -42.62 | 53.37 | 27.46 | 18.04 | 1.17 |
| | 185 | | 30.86 | -30.86 | 76.41 | 198.64 | 8.89 | 0.37 |
| | 213 - 215 | | 59.6 | -59.60 | 69.14 | 18.15 | 11.53 | 2.33 |
| TUL92A-163 | 18 - 20 | | 46.63 | -46.63 | 84.06 | 8.02 | 6.60 | 5.75 |
| | 43 - 45 | | 46.37 | -46.37 | 91.41 | 5.12 | 2.72 | 11.66 |
| | 65 - 67 | | 44 | -44.00 | 80.00 | 9.84 | 8.71 | 4.31 |
| | 71 - 73 | | 38.83 | -38.83 | 66.12 | 18.93 | 12.87 | 2.08 |
| | 92 - 94 | | 50.55 | -50.55 | 84.34 | 8.88 | 5.52 | 5.86 |
| | 133 - 135 | | 30.53 | -30.53 | 40.20 | 34.25 | 22.76 | 0.71 |
| | 163 - 165 | | 45.1 | -45.10 | 86.15 | 7.42 | 5.15 | 6.85 |
| | 197 - 199 | | 55 | -55.00 | 80.40 | 11.76 | 7.20 | 4.24 |

| core | interval | mean | std. dev. | comments (2) | Facies (3) |
|---|---|---|---|---|---|
| PAR91A-14 | 18 - 20 | 6.21 | 2.670425 | m/w | 4b? |
| | 78 - 80 | 6.95 | 2.699191 | | 2 |
| | 175 - 177 | 5.12 | 2.727042 | | 1/2 |
| | 245 - 247 | 6.70 | 2.876147 | | 1/2 |
| | 300 - 302 | 6.60 | 2.931298 | m | 1 |
| | 390 - 392 | 5.66 | 2.976584 | m | 1 |
| PAR91A-26 | 15 - 17 | 6.48 | 3.027764 | | 2/3? |
| | 70 - 72 | 6.84 | 3.128868 | m | 1 |
| | 150 - 152 | 6.50 | 3.06671 | | 1/2 |
| | 198 - 200 | 6.15 | 3.136906 | | 1/2 |
| | 290 - 292 | 6.14 | 3.143684 | | 2? |
| | 360 - 362 | 6.50 | 3.215062 | m/w | 1/2 |
| | 420 - 422 | 6.10 | 3.10269 | m | 2? |
| TUL92A-79 | 30 - 32 | 5.30 | 3.032307 | w | 1/2 |
| | 59 - 61 | 5.34 | 3.108173 | w/s | 1/2 |
| | 130 - 132 | 6.28 | 3.130104 | w | 1 |
| | 175 - 177 | 2.22 | 0.651013 | m | 4 |
| | 198 - 200 | 4.32 | 2.83196 | m | 4 |
| | 220 - 222 | 2.37 | 0.678491 | m/w | 4 |
| | 250 - 252 | 6.02 | 3.016267 | m | 1 |
| | 335 - 337 | 5.04 | 2.866554 | m | 2? |
| | 375 - 377 | 5.07 | 2.926805 | w | 2/3? |
| | 425 - 427 | 2.77 | 0.630464 | m/w/s | 3/4b |
| TUL92A-112 | 10 - 12 | 4.60 | 2.348319 | | 2/3? |
| TUL92A-162 | 15 - 17 | 4.53 | 2.692935 | m | 3 |
| | 45 - 47 | 4.88 | 2.848009 | s | 2 |
| | 80 - 82 | 4.79 | 2.733468 | w/s | 1 |
| | 135 - 137 | 5.42 | 2.927643 | s | 1 |
| | 170 - 172 | 5.24 | 2.931832 | m/w | 1 |
| | 185 | 3.86 | 2.531324 | m | 2/3 |
| | 213 - 215 | 4.20 | 2.7798 | m/w | 3/4b |
| TUL92A-163 | 18 - 20 | 3.37 | 2.11574 | m | 4b |
| | 43 - 45 | 3.07 | 1.524768 | m | 4 |
| | 65 - 67 | 3.71 | 2.47054 | m | 4 |
| | 71 - 73 | 4.28 | 2.721866 | m/w | 3? |
| | 92 - 94 | 3.63 | 1.929138 | m/w | 4 |
| | 133 - 135 | 5.75 | 2.80304 | m/w | 3 |
| | 163 - 165 | 3.39 | 2.011348 | m/w | 3/4 |
| | 197 - 199 | 3.67 | 2.37467 | m/w/s | 3/4 |

Note (1) All intervals in cm below top of core

| Note (2) | Key to comments |
|---|---|
| m | mica flakes |
| s | shelly debris |
| w | wood fragments |
| fv | fish vertebrae |

| Note (3) | |
|---|---|
| 1 | silty clay |
| 2 | clayey silt with <10% discrete fine sand laminae |
| 3 | interbedded clayey silt/very fine to medium sand |
| 4a | very fine to medium sand with <10% silty laminae |
| 4b | very fine to fine sand beds <10cm thick |
| 4c | massive fine to medium sand |
| 5 | debris flow |

# APPENDIX C2: FRASER RIVER DELTA STUDY
# CUMULATIVE PERCENT GRAIN SIZE DATA

| core | interval | <-1.0 phi | -1.0 - 1.0 | 1.0 - 2.0 | 2.0 - 3.0 | 3.0 - 4.0 | 4.0 - 5.0 | 5.0 - 6.0 |
|---|---|---|---|---|---|---|---|---|
| VEC89A-01 | 0 - 5 | 0.00 | 0.06 | 0.35 | 1.47 | 19.74 | 26.16 | 29.61 |
|  | 573 - 580 | 0.00 | 0.13 | 1.03 | 2.85 | 27.26 | 31.41 | 33.66 |
| VEC89A-03 | 8 - 12 | 0.00 | 0.13 | 0.63 | 11.05 | 58.33 | 67.41 | 70.70 |
|  | 12 - 15 | 0.08 | 0.75 | 1.43 | 28.83 | 87.66 | 93.19 | 94.40 |
|  | 30 - 31 | 0.00 | 0.25 | 0.76 | 5.78 | 38.08 | 47.67 | 51.58 |
|  | 35 - 40 | 0.01 | 0.20 | 0.54 | 5.68 | 44.37 | 57.11 | 61.50 |
|  | 70 - 72 | 0.00 | 0.57 | 1.62 | 27.62 | 82.94 | 89.32 | 90.99 |
|  | 75 - 80 | 0.38 | 0.89 | 1.44 | 14.70 | 65.41 | 76.76 | 80.25 |
|  | 95 - 97 | 0.00 | 0.03 | 2.20 | 10.04 | 40.59 | 49.62 | 53.24 |
|  | 110 | 0.32 | 1.91 | 25.53 | 69.55 | 92.61 | 95.40 | 96.11 |
|  | 116 | 0.00 | 0.31 | 0.66 | 8.33 | 16.08 | 20.53 | 23.22 |
|  | 125 | 0.00 | 0.46 | 24.44 | 79.75 | 97.44 | n/a | n/a |
|  | 145 | 0.00 | 0.65 | 25.39 | 78.70 | 96.56 | n/a | n/a |
|  | 170 | 1.32 | 8.46 | 27.32 | 63.14 | 89.97 | 93.24 | 94.40 |
|  | 173 | 0.04 | 0.32 | 3.47 | 16.61 | 59.01 | 67.99 | 71.23 |
|  | 210 | 0.87 | 2.60 | 44.78 | 88.38 | 98.23 | n/a | n/a |
|  | 220 | 0.00 | 0.09 | 10.20 | 36.54 | 57.98 | 63.40 | 66.01 |
| VEC89A-06 | 35 | 0.00 | 0.00 | 0.27 | 3.35 | 32.09 | 41.67 | 45.94 |
|  | 66 | 0.00 | 0.00 | 1.27 | 23.98 | 86.85 | n/a | n/a |
|  | 100 | 0.00 | 0.31 | 5.94 | 33.52 | 59.11 | 63.40 | 65.57 |
| VEC89A-07 | 285 - 295 | 0.00 | 0.07 | 0.42 | 2.67 | 32.27 | 35.79 | 38.09 |
|  | 332 | 0.00 | 0.06 | 0.13 | 1.59 | 34.14 | 37.96 | 39.94 |
|  | 380 - 390 | 0.00 | 0.00 | 0.20 | 0.70 | 26.18 | 34.08 | 37.62 |
| VEC89A-18 | 50 | 0.00 | 0.00 | 0.06 | 0.54 | 12.37 | 19.21 | 22.80 |
|  | 245 | 0.00 | 0.30 | 7.39 | 26.03 | 76.04 | 86.46 | 89.10 |
|  | 260 | 0.00 | 0.00 | 0.49 | 2.57 | 21.75 | 27.15 | 30.12 |
|  | 330 | 0.00 | 1.00 | 14.86 | 49.42 | 86.28 | 92.00 | 93.34 |
|  | 360 | 0.00 | 0.65 | 22.76 | 67.64 | 96.08 | n/a | n/a |
|  | 375 - 380 | 0.03 | 0.69 | 16.54 | 58.19 | 94.52 | 96.26 | 96.69 |
| VEC89A-20 | 295 | 0.00 | 0.02 | 0.02 | 1.16 | 27.53 | 36.44 | 40.79 |
|  | 400 | 0.00 | 0.00 | 2.34 | 53.00 | 95.05 | 96.62 | 96.99 |
|  | 420 | 0.11 | 0.58 | 1.92 | 35.27 | 85.35 | 90.33 | 91.75 |
| VEC89A-21 | 50 - 55 | 0.00 | 0.00 | 0.46 | 1.98 | 17.86 | 24.68 | 28.05 |
|  | 90 - 95 | 0.00 | 0.10 | 0.15 | 1.36 | 23.23 | 32.14 | 36.29 |
|  | 300 - 305 | 0.00 | 0.00 | 2.58 | 5.80 | 28.39 | 36.84 | 40.56 |
|  | 307 - 310 | 0.00 | 0.00 | 5.15 | 14.82 | 39.37 | 47.37 | 51.07 |
| VEC89A-23 | 127 | 0.23 | 2.22 | 8.04 | 22.38 | 79.09 | 87.89 | 89.94 |
|  | 150 | 0.00 | 0.06 | 0.73 | 3.53 | 18.34 | 23.89 | 26.74 |
|  | 180 | 0.00 | 0.64 | 13.36 | 53.53 | 89.67 | 93.27 | 94.19 |
| VEC89A-25 | 15 | 0.00 | 1.60 | 38.77 | 91.02 | 98.41 | n/a | n/a |
|  | 70 | 0.00 | 1.67 | 48.54 | 93.37 | 99.52 | n/a | n/a |
|  | 130 | 0.00 | 1.42 | 46.52 | 94.23 | 99.48 | n/a | n/a |

| core | interval | <-1.0 phi | -1.0 - 1.0 | 1.0 - 2.0 | 2.0 - 3.0 | 3.0 - 4.0 | 4.0 - 5.0 | 5.0 - 6.0 |
|---|---|---|---|---|---|---|---|---|
| VEC89A-39 | 17 | 0.02 | 0.11 | 0.57 | 3.27 | 50.82 | 58.15 | 60.90 |
| | 32 | 0.20 | 2.48 | 13.40 | 46.30 | 74.09 | 77.98 | 79.46 |
| | 70 | 0.00 | 0.14 | 16.09 | 70.78 | 94.49 | 95.69 | 96.08 |
| | 100 | 0.00 | 0.27 | 21.67 | 78.90 | 98.00 | n/a | n/a |
| | 125 | 1.06 | 4.18 | 18.74 | 61.98 | 84.16 | 86.04 | 86.77 |
| | basal sand | 1.54 | 9.25 | 21.55 | 58.55 | 93.28 | 94.75 | 95.16 |
| VEC89A-40 | 20 | 0.00 | 0.00 | 0.23 | 4.48 | 31.11 | 40.75 | 45.37 |
| | 25 | 12.80 | 38.71 | 50.06 | 73.50 | 93.01 | n/a | n/a |
| | 30 | 0.00 | 2.65 | 6.31 | 13.35 | 37.56 | 42.18 | 44.86 |
| VEC89A-41 | 20 - 23 | 0.00 | 0.19 | 13.44 | 38.35 | 67.54 | 70.62 | 72.21 |
| | 60 - 62 | 0.01 | 0.39 | 28.10 | 87.94 | 99.34 | n/a | n/a |
| | 90 | 0.01 | 0.52 | 23.64 | 70.73 | 96.68 | 98.05 | 98.36 |
| | 120 | 0.00 | 0.16 | 23.00 | 55.57 | 74.52 | 78.37 | 80.13 |
| | 140 | 0.00 | 0.32 | 29.41 | 81.05 | 98.07 | n/a | n/a |
| VEC89A-42 | 0 - 5 | 0.00 | 0.11 | 2.44 | 18.65 | 60.56 | 67.11 | 69.79 |
| | 44 - 46 | 0.00 | 0.19 | 10.39 | 60.82 | 92.72 | 95.92 | 96.63 |
| | 58 - 62 | 0.00 | 0.29 | 9.30 | 44.97 | 74.26 | 77.74 | 79.31 |
| | 28 - 30 | 0.00 | 0.63 | 2.24 | 19.25 | 69.95 | 77.94 | 80.67 |
| VEC89A-44 | 15 - 20 | 0.00 | 0.42 | 1.83 | 10.64 | 44.73 | 48.76 | 50.81 |
| | 25 - 28 | 0.00 | 0.34 | 14.49 | 47.27 | 73.74 | 77.81 | 79.28 |
| | 28 - 32 | 0.00 | 0.64 | 31.10 | 82.03 | 97.09 | 97.81 | 98.04 |
| | 50 | 0.00 | 0.54 | 31.98 | 84.32 | 98.94 | n/a | n/a |
| | 100 | 0.00 | 0.45 | 29.93 | 85.54 | 99.14 | n/a | n/a |
| VEC89A-42 | 150 | 0.09 | 1.23 | 46.14 | 90.94 | 99.37 | n/a | n/a |
| | 200 | 0.00 | 0.18 | 18.27 | 77.26 | 97.90 | 98.50 | 98.69 |
| | 165 | 0.00 | 0.44 | 7.10 | 38.04 | 65.91 | 69.56 | 71.30 |
| | 173 | 0.00 | 0.08 | 4.38 | 28.24 | 59.30 | 65.81 | 68.86 |
| | 254 | 0.28 | 2.55 | 12.53 | 33.59 | 73.83 | 80.37 | 82.86 |
| | 259 | 0.10 | 1.44 | 14.79 | 53.43 | 91.55 | 94.84 | 95.66 |
| | 262 - 265 | 0.00 | 0.07 | 1.33 | 15.63 | 51.45 | 56.21 | 58.49 |
| VEC89A-45 | 10 - 15 | 0.00 | 0.16 | 3.86 | 40.06 | 92.78 | 95.29 | 95.90 |
| | 45 - 50 | 3.30 | 3.96 | 9.04 | 33.48 | 55.33 | 58.86 | 61.14 |
| | 60 - 65 | 0.04 | 1.65 | 6.20 | 61.59 | 89.75 | 91.69 | 92.49 |
| | 90 - 95 | 0.03 | 1.43 | 14.79 | 54.72 | 87.28 | 90.64 | 91.63 |
| | 103 - 105 | 0.00 | 4.41 | 16.32 | 34.12 | 61.94 | 64.76 | 66.17 |
| | 140 | 0.00 | 0.15 | 15.71 | 68.12 | 97.05 | n/a | n/a |
| | 144 | 0.00 | 7.75 | 32.43 | 63.96 | 78.74 | n/a | n/a |
| VEC89A-46 | 20 | 0.00 | 0.00 | 1.49 | 34.00 | 75.36 | 80.58 | 82.53 |
| | 35A | 0.00 | 0.00 | 1.32 | 59.74 | 85.24 | 88.07 | 89.13 |
| | 35B | 0.00 | 0.00 | 0.72 | 44.89 | 72.93 | 76.34 | 77.80 |
| | 60 | 0.00 | 0.24 | 6.78 | 68.93 | 95.39 | n/a | n/a |
| | 85 | 0.00 | 1.22 | 15.88 | 55.87 | 85.95 | 89.39 | 90.53 |
| | 95 - 97 | 0.00 | 0.00 | 3.59 | 27.68 | 53.53 | 60.27 | 63.24 |

| core | interval | <-1.0 phi | -1.0 - 1.0 | 1.0 - 2.0 | 2.0 - 3.0 | 3.0 - 4.0 | 4.0 - 5.0 | 5.0 - 6.0 |
|---|---|---|---|---|---|---|---|---|
| PAR91A-14 | 18 - 20 | 0 | 0.12 | 1.39 | 4.32 | 29.37 | 37.59 | 41.94 |
| | 78 - 80 | 0 | 0.05 | 2.2 | 3.85 | 19.39 | 27.21 | 31.40 |
| | 175 - 177 | 0.16 | 0.83 | 14.3 | 19.97 | 45.45 | 53.35 | 56.95 |
| | 245 - 247 | 0 | 0.14 | 2.73 | 7.64 | 23.52 | 29.88 | 33.25 |
| | 300 - 302 | 0 | 0.11 | 4.64 | 11.11 | 26.42 | 31.69 | 34.43 |
| | 390 - 392 | 0 | 0.16 | 5.9 | 16.06 | 43.94 | 48.57 | 51.24 |
| PAR91A-26 | 15 - 17 | 0 | 0 | 1.17 | 3.03 | 32.59 | 38.17 | 40.90 |
| | 70 - 72 | 0 | 0 | 0.43 | 2.64 | 30.9 | 34.77 | 37.04 |
| | 150 - 152 | 0 | 0 | 0.31 | 2.18 | 35.87 | 41.04 | 43.72 |
| | 198 - 200 | 0 | 0.42 | 0.79 | 5.47 | 42.62 | 45.80 | 47.44 |
| | 290 - 292 | 0 | 0.14 | 0.49 | 3.99 | 42.73 | 46.79 | 49.06 |
| | 360 - 362 | 0 | 0 | 2.12 | 6.36 | 37.21 | 40.59 | 42.40 |
| | 420 - 422 | 0 | 0.14 | 0.46 | 4.55 | 43 | 47.29 | 49.41 |
| TUL92A-79 | 30 - 32 | 0.12 | 1.87 | 2.92 | 9.51 | 57.06 | 59.61 | 61.09 |
| | 59 - 61 | 0.53 | 2.12 | 4.34 | 13.14 | 55.08 | 58.62 | 60.48 |
| | 130 - 132 | 0 | 0.19 | 1.14 | 6.84 | 43.53 | 48.60 | 51.34 |
| | 175 - 177 | 0 | 0.68 | 33.73 | 87.5 | 98.28 | n/a | n/a |
| | 198 - 200 | 0 | 0.04 | 8.65 | 42.17 | 68.3 | 72.15 | 74.01 |
| | 220 - 222 | 0 | 0.91 | 20.86 | 76.46 | 95.99 | n/a | n/a |
| | 250 - 252 | 0 | 0 | 0.67 | 6.75 | 42.03 | 48.36 | 51.13 |
| | 335 - 337 | 0 | 0 | 0.64 | 14.41 | 65.1 | 68.35 | 69.71 |
| | 375 - 377 | 0 | 0.1 | 0.34 | 21.69 | 55.31 | 60.12 | 62.34 |
| | 425 - 427 | 0 | 0.55 | 5.8 | 51.08 | 95.57 | n/a | n/a |
| TUL92A-112 | 10 - 12 | 0.00 | 0 | 1.21 | 9.40 | 67.55 | 74.33 | 76.85 |
| TUL92A-162 | 15 - 17 | 0 | 0 | 0.38 | 28.07 | 68.33 | 72.21 | 73.93 |
| | 45 - 47 | 0 | 0.22 | 0.88 | 17.64 | 62.11 | 67.29 | 69.57 |
| | 80 - 82 | 0.02 | 0.05 | 1.29 | 11.34 | 42.3 | 48.13 | 51.00 |
| | 135 - 137 | 0 | 0 | 2.16 | 14.9 | 50.17 | 55.48 | 58.26 |
| | 170 - 172 | 0 | 0.09 | 2.62 | 17.19 | 53.37 | 60.50 | 63.62 |
| | 185 | 0 | 0.29 | 16.07 | 41.54 | 76.41 | 79.94 | 81.40 |
| | 213 - 215 | 0 | 0 | 12.13 | 42.63 | 69.14 | 73.42 | 75.40 |
| TUL92A-163 | 18 - 20 | 0 | 0.06 | 7.35 | 66.69 | 84.06 | 85.47 | 86.21 |
| | 43 - 45 | 0 | 0.09 | 5.1 | 66.89 | 91.41 | 92.71 | 93.26 |
| | 65 - 67 | 0 | 0.07 | 6.5 | 56.75 | 80 | 81.79 | 82.71 |
| | 71 - 73 | 0 | 0.08 | 4.1 | 50.51 | 66.12 | 68.67 | 70.25 |
| | 92 - 94 | 0 | 0.20 | 2.69 | 39.39 | 84.34 | 86.40 | 87.32 |
| | 133 - 135 | 0 | 0.10 | 1.12 | 10.62 | 40.2 | 46.24 | 49.49 |
| | 163 - 165 | 0 | 0.03 | 6.68 | 55.46 | 86.15 | 87.95 | 88.72 |
| | 197 - 199 | 0 | 1.10 | 13.95 | 45.84 | 80.4 | 83.82 | 85.20 |

| core | interval | 6.0 - 7.0 | 7.0 - 8.0 | 8.0 - 9.0 | 9.0 - 10.0 | 0.0 - 11.0 | 11.0 - 12.0 | >12.0 |
|---|---|---|---|---|---|---|---|---|
| VEC89A-01 | 0 - 5 | 44.86 | 59.54 | 75.75 | 79.76 | 84.66 | 88.91 | 98.46 |
| | 573 - 580 | 44.64 | 56.86 | 73.59 | 78.54 | 84.36 | 88.22 | 99.05 |
| VEC89A-03 | 8 - 12 | 79.66 | 85.16 | 89.70 | 90.87 | 92.25 | 93.08 | 97.91 |
| | 12 - 15 | 96.50 | 97.23 | 97.79 | 97.89 | 98.14 | 98.29 | 98.25 |
| | 30 - 31 | 65.82 | 76.41 | 86.75 | 89.29 | 93.13 | 95.61 | 98.77 |
| | 35 - 40 | 74.79 | 83.36 | 90.81 | 92.31 | 94.70 | 95.92 | 97.03 |
| | 70 - 72 | 94.32 | 95.79 | 96.95 | 97.34 | 97.90 | 98.14 | 98.92 |
| | 75 - 80 | 88.41 | 92.30 | 95.78 | 96.40 | 97.37 | 97.75 | 97.75 |
| | 95 - 97 | 65.54 | 75.40 | 86.21 | 88.82 | 92.50 | 95.41 | 98.14 |
| | 110 | 97.68 | 98.23 | 98.61 | 98.72 | 98.83 | 98.89 | 99.58 |
| | 116 | 39.22 | 60.73 | 81.63 | 86.16 | 92.45 | 95.89 | 99.25 |
| | 125 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | 145 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | 170 | 96.95 | 98.07 | 98.89 | 99.03 | 99.27 | 99.43 | 99.61 |
| | 173 | 80.25 | 86.11 | 91.73 | 93.12 | 95.42 | 96.85 | 98.57 |
| | 210 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | 220 | 76.14 | 84.75 | 92.10 | 93.70 | 95.97 | 97.4 | 99.16 |
| VEC89A-06 | 35 | 60.20 | 72.49 | 83.83 | 86.75 | 89.81 | 91.92 | 99.59 |
| | 66 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | 100 | 73.57 | 81.09 | 88.73 | 90.69 | 92.98 | 94.78 | 99.11 |
| VEC89A-07 | 285 - 295 | 49.06 | 61.39 | 77.37 | 82.11 | 87.39 | 91.32 | 99.18 |
| | 332 | 50.02 | 61.68 | 78.15 | 84.87 | 90.80 | 94.88 | 100.02 |
| | 380 - 390 | 51.57 | 63.75 | 78.14 | 82.42 | 87.22 | 90.32 | 98.37 |
| VEC89A-18 | 50 | 39.98 | 55.32 | 73.11 | 78.46 | 84.51 | 88.89 | 97.92 |
| | 245 | 93.56 | 95.14 | 96.27 | 96.63 | 96.94 | 97.13 | 98.59 |
| | 260 | 43.84 | 57.66 | 75.27 | 80.28 | 86.23 | 90.14 | 98.54 |
| | 330 | 95.91 | 96.93 | 97.67 | 97.89 | 98.05 | 98.1 | 99.07 |
| | 360 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | 375 - 380 | 97.72 | 98.29 | 98.77 | 98.91 | 99.03 | 99.16 | 99.57 |
| VEC89A-20 | 295 | 58.18 | 73.18 | 86.95 | 90.57 | 95.57 | 97.82 | 99.34 |
| | 400 | 97.84 | 98.35 | 98.75 | 98.88 | 98.96 | 99.07 | 99.59 |
| | 420 | 94.84 | 96.52 | 97.78 | 98.04 | 98.48 | 98.64 | 99.12 |
| VEC89A-21 | 50 - 55 | 43.41 | 57.54 | 73.39 | 78.40 | 85.63 | 90.48 | 99.35 |
| | 90 - 95 | 53.56 | 66.69 | 79.36 | 82.97 | 87.12 | 90.42 | 98.87 |
| | 300 - 305 | 56.74 | 70.06 | 82.02 | 85.46 | 89.33 | 92.62 | 99.35 |
| | 307 - 310 | 65.08 | 75.75 | 85.39 | 88.06 | 90.97 | 93.52 | 98.79 |
| VEC89A-23 | 127 | 93.39 | 94.41 | 95.2 | 95.37 | 95.68 | 95.85 | 98.4 |
| | 150 | 41.61 | 57.13 | 74.28 | 79.51 | 85.47 | 90.21 | 99.6 |
| | 180 | 96.16 | 97.15 | 97.97 | 98.20 | 98.45 | 98.63 | 99.38 |
| VEC89A-25 | 15 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | 70 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | 130 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |

| core | interval | 6.0 - 7.0 | 7.0 - 8.0 | 8.0 - 9.0 | 9.0 - 10.0 | 10.0 - 11.0 | 11.0 - 12. | >12.0 |
|---|---|---|---|---|---|---|---|---|
| VEC89A-39 | 17 | 70.20 | 77.97 | 86.28 | 88.64 | 91.30 | 92.68 | 99.27 |
| | 32 | 84.38 | 88.42 | 92.67 | 93.73 | 95.16 | 95.65 | 99.59 |
| | 70 | 97.29 | 98.13 | 98.90 | 99.06 | 99.29 | 99.4 | 99.73 |
| | 100 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | 125 | 89.83 | 92.62 | 95.20 | 95.82 | 96.69 | 97.36 | 99.58 |
| | basal sand | 96.40 | 97.31 | 98.12 | 98.34 | 98.61 | 98.74 | 99.68 |
| VEC89A-40 | 20 | 63.28 | 77.40 | 88.97 | 91.86 | 95.72 | 97.3 | 99.16 |
| | 25 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | 30 | 55.97 | 68.33 | 82.56 | 86.43 | 90.80 | 93.54 | 99.53 |
| VEC89A-41 | 20 - 23 | 78.80 | 85.19 | 92.17 | 93.96 | 96.1 | 97.82 | 99.38 |
| | 60 - 62 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | 90 | 98.91 | 99.16 | 99.35 | 99.39 | 99.45 | 99.53 | 99.65 |
| | 120 | 86.68 | 91.88 | 95.93 | 96.92 | 97.91 | 98.55 | 99.31 |
| | 140 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| VEC89A-42 | 0 - 5 | 78.51 | 84.82 | 91.21 | 93.02 | 95.23 | 96.77 | 98.78 |
| | 44 - 46 | 97.75 | 98.26 | 98.68 | 98.80 | 98.93 | 98.97 | 99.2 |
| | 58 - 62 | 84.84 | 89.16 | 93.44 | 95.03 | 96.55 | 97.55 | 99.15 |
| | 28 - 30 | 87.22 | 90.77 | 94.14 | 95.07 | 96.21 | 97.14 | 98.01 |
| VEC89A-44 | 15 - 20 | 59.87 | 69.21 | 81.48 | 85.02 | 89.17 | 92.6 | 99.45 |
| | 25 - 28 | 84.32 | 88.23 | 92.64 | 93.90 | 95.37 | 96.45 | 99.47 |
| | 28 - 32 | 98.64 | 99.00 | 99.34 | 99.43 | 99.56 | 99.63 | 99.8 |
| | 50 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | 100 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| VEC89A-42 | 150 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | 200 | 99.20 | 99.48 | 99.68 | 99.71 | 99.77 | 99.79 | 99.88 |
| | 165 | 78.02 | 84.16 | 90.64 | 92.28 | 94.15 | 95.79 | 99.51 |
| | 173 | 78.55 | 85.02 | 90.88 | 92.47 | 94.22 | 95.81 | 99.51 |
| | 254 | 88.85 | 91.81 | 94.69 | 95.45 | 96.34 | 97.18 | 99.35 |
| | 259 | 97.14 | 97.78 | 98.28 | 98.42 | 98.55 | 98.67 | 99.45 |
| | 262 - 265 | 67.52 | 75.29 | 84.95 | 87.62 | 90.73 | 93.01 | 99.27 |
| VEC89A-45 | 10 - 15 | 97.34 | 98.22 | 98.99 | 99.13 | 99.27 | 99.36 | 99.48 |
| | 45 - 50 | 70.03 | 78.29 | 87.63 | 90.40 | 93.57 | 95.45 | 99.52 |
| | 60 - 65 | 94.81 | 96.34 | 97.92 | 98.30 | 98.66 | 98.94 | 99.88 |
| | 90 - 95 | 94.03 | 95.52 | 97.03 | 97.44 | 97.92 | 98.3 | 99.48 |
| | 103 - 105 | 72.72 | 80.45 | 88.21 | 90.46 | 93.35 | 95.48 | 99.13 |
| | 140 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | 144 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| VEC89A-46 | 20 | 88.49 | 92.09 | 95.22 | 95.96 | 97.07 | 97.83 | 99.16 |
| | 35A | 92.66 | 95.08 | 97.19 | 97.71 | 98.52 | 99.04 | 99.56 |
| | 35B | 83.43 | 88.33 | 93.15 | 94.48 | 96.32 | 97.67 | 99.27 |
| | 60 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | 85 | 93.78 | 95.78 | 97.54 | 97.99 | 98.48 | 98.93 | 99.44 |
| | 95 - 97 | 75.37 | 83.87 | 90.93 | 92.70 | 95.02 | 97.06 | 98.78 |

| core | interval | 6.0 - 7.0 | 7.0 - 8.0 | 8.0 - 9.0 | 9.0 - 10.0 | 10.0 - 11.0 | 11.0 - 12. | >12.0 |
|---|---|---|---|---|---|---|---|---|
| PAR91A-14 | 18 - 20 | 60.11 | 72.54 | 83.38 | 86.90 | 90.77 | 94.22 | 97.88 |
| | 78 - 80 | 49.70 | 65.34 | 79.05 | 83.48 | 89.37 | 95.42 | 99.29 |
| | 175 - 177 | 71.34 | 83.00 | 91.88 | 93.95 | 95.97 | 97.66 | 98.97 |
| | 245 - 247 | 47.39 | 60.93 | 75.44 | 80.00 | 86.66 | 92.72 | 96.83 |
| | 300 - 302 | 49.29 | 64.15 | 78.80 | 83.13 | 89.41 | 93.74 | 98.14 |
| | 390 - 392 | 63.83 | 74.57 | 84.33 | 87.27 | 91.25 | 94.85 | 98.28 |
| PAR91A-26 | 15 - 17 | 51.67 | 62.38 | 75.10 | 79.12 | 84.83 | 88.59 | 96.44 |
| | 70 - 72 | 47.91 | 58.52 | 71.26 | 75.60 | 82.00 | 87 | 96.94 |
| | 150 - 152 | 55.18 | 65.52 | 76.79 | 80.34 | 85.45 | 89.81 | 98.09 |
| | 198 - 200 | 55.65 | 65.29 | 77.06 | 80.67 | 85.87 | 89.21 | 96.88 |
| | 290 - 292 | 58.89 | 67.73 | 77.34 | 80.40 | 84.90 | 88.57 | 97.24 |
| | 360 - 362 | 50.74 | 60.35 | 73.82 | 78.05 | 84.27 | 88.32 | 97.14 |
| | 420 - 422 | 57.82 | 66.34 | 77.58 | 81.10 | 86.37 | 89.74 | 97.12 |
| TUL92A-79 | 30 - 32 | 67.84 | 74.96 | 83.56 | 86.11 | 89.44 | 92.03 | 97.34 |
| | 59 - 61 | 67.74 | 74.96 | 83.95 | 86.59 | 89.96 | 92.6 | 98.04 |
| | 130 - 132 | 62.35 | 71.73 | 81.86 | 85.47 | 90.54 | 93.92 | 101.25 |
| | 175 - 177 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | 198 - 200 | 80.58 | 85.51 | 90.07 | 91.40 | 93.44 | 94.84 | 98.65 |
| | 220 - 222 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | 250 - 252 | 62.10 | 71.49 | 81.50 | 84.50 | 88.34 | 91.62 | 98.4 |
| | 335 - 337 | 75.22 | 81.15 | 88.13 | 90.22 | 92.63 | 94.48 | 99.54 |
| | 375 - 377 | 70.42 | 77.32 | 84.85 | 87.03 | 89.62 | 91.63 | 96.65 |
| | 425 - 427 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| TUL92A-112 | 10 - 12 | 84.55 | 89.14 | 92.88 | 93.96 | 95.27 | 96.29 | 99.3 |
| TUL92A-162 | 15 - 17 | 80.46 | 85.57 | 89.97 | 91.11 | 92.90 | 94.01 | 98.38 |
| | 45 - 47 | 77.17 | 82.68 | 87.38 | 88.59 | 90.61 | 91.6 | 97.88 |
| | 80 - 82 | 61.45 | 69.52 | 76.38 | 78.22 | 80.91 | 82.35 | 86.52 |
| | 135 - 137 | 70.10 | 78.73 | 86.19 | 88.09 | 90.92 | 92.38 | 98.37 |
| | 170 - 172 | 73.88 | 80.83 | 86.61 | 88.38 | 91.60 | 93 | 98.87 |
| | 185 | 86.43 | 90.05 | 93.14 | 93.98 | 95.30 | 96.2 | 98.94 |
| | 213 - 215 | 82.50 | 87.29 | 91.24 | 92.32 | 93.91 | 94.87 | 98.82 |
| TUL92A-163 | 18 - 20 | 89.28 | 92.08 | 95.03 | 95.86 | 96.85 | 97.92 | 98.68 |
| | 43 - 45 | 95.14 | 96.53 | 97.67 | 98.00 | 98.39 | 98.72 | 99.25 |
| | 65 - 67 | 86.57 | 89.84 | 92.70 | 93.57 | 94.85 | 95.9 | 98.55 |
| | 71 - 73 | 77.97 | 85.05 | 90.61 | 92.16 | 94.33 | 96.27 | 97.92 |
| | 92 - 94 | 90.61 | 93.22 | 95.50 | 96.20 | 97.03 | 97.76 | 98.74 |
| | 133 - 135 | 63.36 | 74.45 | 84.03 | 86.99 | 90.36 | 93.55 | 97.21 |
| | 163 - 165 | 91.46 | 93.57 | 95.35 | 95.83 | 96.56 | 96.96 | 98.72 |
| | 197 - 199 | 89.50 | 92.16 | 94.54 | 95.13 | 96.09 | 96.8 | 99.36 |

# APPENDIX D: DOIG STUDY

## LIST OF CORES

| UWI | Formation(s) | Core Length | Top Core | Base Core | Halfway Top | Top Core | Base Core | Area | Field |
|---|---|---|---|---|---|---|---|---|---|
| | | | (Drill Depth) | | | (Sub - Halfway) | | | |
| 8-18-80-17/w6 | Doig | 21.60 | 2034.00 | 2055.60 | 1986.00 | -48.00 | -69.60 | Regional | |
| 8-09-80-21/w6 | Doig | 4.00 | 2461.00 | 2465.00 | 2415.00 | -46.00 | -50.00 | Regional | |
| | Doig | 9.95 | 2466.00 | 2475.95 | 2415.00 | -51.00 | -60.95 | Regional | |
| 11-34-84-15/w6 | Doig | 15.00 | 1531.80 | 1546.80 | 1518.00 | -13.80 | -28.80 | Regional | |
| 12-24-84-21/w6 | Doig | 14.85 | 1654.00 | 1668.85 | 1616.00 | -38.00 | -52.85 | Regional | |
| 11-31-85-21/w6 | Doig | 17.90 | 1705.00 | 1722.90 | 1665.00 | -40.00 | -57.90 | Regional | Red Creek ? |
| (02) 6-04-86-20/w6 | Doig | 17.45 | 1598.00 | 1615.45 | 1538.00 | -60.00 | -77.45 | Stoddart | B Pool |
| 12-04-86-20/w6 | Doig | 17.47 | 1593.00 | 1610.47 | 1533.00 | -60.00 | -77.47 | Stoddart | B Pool |
| 16-15-86-20/w6 | Doig | 10.50 | 1542.30 | 1552.80 | 1564.00 | 21.70 | 11.20 | Stoddart | C Pool |
| 10-25-86-20/w6 | Doig | 17.30 | 1490.24 | 1507.54 | 1474.00 | -16.24 | -33.54 | Stoddart | |
| 10-19-87-19/w6 | ChLk - Doig | 37.80 | 1490.80 | 1528.60 | 1502.50 | 11.70 | -26.10 | Stoddart | |
| 6-22-87-20/w6 | Hfwy - Doig | 5.14 | 1578.86 | 1584.00 | 1582.20 | 3.34 | -1.80 | Stoddart | A Pool |
| | Doig | 12.40 | 1584.96 | 1597.36 | 1582.20 | -2.76 | -15.16 | Stoddart | A Pool |
| (02) 6-26-87-21/w6 | Hfwy | 13.30 | 1605.50 | 1618.80 | 1605.30 | -0.20 | -13.50 | Stoddart | |
| 6-03-88-14/w6 | ChLk - Doig | 16.80 | 1340.40 | 1357.20 | u/c 1344.2 | 3.80 | -13.00 | Regional | |
| 9-19-88-16/w6 | Hfwy - Doig | 18.39 | 1269.60 | 1287.99 | 1275.80 | 6.20 | -12.19 | Regional | Rigel ? |
| 6-21-88-19/w6 | ChLk - Hfwy | 15.00 | 1429.00 | 1444.00 | 1438.40 | 9.40 | -5.60 | Regional | |
| 7-24-88-20/w6 | Hfwy | 14.40 | 1465.20 | 1479.60 | 1463.20 | -2.00 | -16.40 | Buick Creek | Regional |
| 9-34-88-20/w6 | Doig | 36.40 | 1410.70 | 1447.10 | 1386.00 | -24.70 | -61.10 | Buick Creek | Buick Creek |
| a-30-L/94-A-05 | Hfwy-Doig | 13.10 | 1788.57 | 1801.67 | ? | ? | ? | Regional | |
| | Doig | 23.70 | 1804.11 | 1827.81 | ? | ? | ? | Regional | |
| a-29-K/94-A-10 | ChLk - Hfwy | 4.80 | 1360.00 | 1364.80 | 1363.90 | 3.90 | -0.90 | Regional | |

| UWI | Formation(s) | Core Length | Top Core | Base Core | Halfway Top | Top Core | Base Core | Area | Field |
|---|---|---|---|---|---|---|---|---|---|
| | | | (Drill Depth) | | | (Sub - Halfway) | | | |
| a-29-K/94-A-10 | Hfwy +/- Doig | 17.20 | 1368.80 | 1386.00 | 1363.90 | -4.90 | -22.10 | Regional | |
| d-87-K/94-A-10 | Hfwy | 13.75 | 1276.50 | 1290.25 | 1273.50 | -3.00 | -16.75 | Regional | |
| d-36-I/94-A-11 | Doig (+/- Hfwy) | 12.80 | 1388.50 | 1401.30 | 1358.00 | -30.50 | -43.30 | Buick Creek | Buick Creek |
| b-44-I/94-A-11 | Doig (+/- Hfwy) | 18.65 | 1395.75 | 1414.40 | 1378.50 | -17.25 | -35.90 | Buick Creek | Buick Creek |
| d-45-I/94-A-11 | Doig | 18.70 | 1406.60 | 1425.30 | 1379.50 | -27.10 | -45.80 | Buick Creek | Buick Creek |
| d-46-I/94-A-11 | Doig | 13.50 | 1361.80 | 1375.30 | 1336.60 | -25.20 | -38.70 | Buick Creek | Buick Creek |
| (02) d-57-I/94-A-11 | Doig | 25.00 | 1352.10 | 1377.10 | 1326.80 | -25.30 | -50.30 | Buick Creek | Buick Creek |
| d-58-I/94-A-11 | Doig | 18.10 | 1367.40 | 1385.50 | 1339.60 | -27.80 | -45.90 | Buick Creek | Buick Creek |
| d-68-I/94-A-11 | Doig | 23.90 | 1393.30 | 1417.20 | 1362.80 | -30.50 | -54.40 | Buick Creek | Buick Creek |
| d-69-I/94-A-11 | Doig | 22.00 | 1445.00 | 1467.00 | 1411.00 | -34.00 | -56.00 | Buick Creek | Buick Creek |
| d-76-I/94-A-11 | Hfwy? + Doig | 12.00 | 1363.00 | 1375.00 | 1334.00 | -29.00 | -41.00 | Buick Creek | Buick Creek |
| | Doig | 18.00 | 1391.60 | 1409.60 | 1334.00 | -57.60 | -75.60 | Buick Creek | Buick Creek |
| b-77-I/94-A-11 | Doig | 12.10 | 1373.00 | 1385.10 | 1344.00 | -29.00 | -41.10 | Buick Creek | Buick Creek |
| | Doig | 17.10 | 1386.70 | 1403.80 | 1344.00 | -42.70 | -59.80 | Buick Creek | Buick Creek |
| d-79-I/94-A-11 | Doig (+/- Hfwy) | 9.00 | 1391.00 | 1400.00 | 1373.00 | -18.00 | -27.00 | Buick Creek | Buick Creek |
| d-85-I/94-A-11 | Doig | 36.40 | 1388.00 | 1424.40 | 1369.50 | -18.50 | -54.90 | Buick Creek | Buick Creek |
| d-86-I/94-A-11 | ChLk - Hfwy (Doig?) | 18.10 | 1370.50 | 1388.60 | 1374.00 | 3.50 | -14.60 | Buick Creek | Buick Creek |
| | Doig | 18.20 | 1395.00 | 1413.20 | 1374.00 | -21.00 | -39.20 | Buick Creek | Buick Creek |
| (02) d-96-I/94-A-11 | ChLk | 8.40 | 1359.60 | 1368.00 | 1369.50 | 9.90 | 1.50 | Buick Creek | Buick Creek |
| | Doig | 27.00 | 1389.00 | 1416.00 | 1369.50 | -19.50 | -46.50 | Buick Creek | Buick Creek |
| (03) d-96-I/94-A-11 | Hfwy/Doig | 41.80 | 1384.50 | 1426.30 | 1370.50 | -14.00 | -55.80 | Buick Creek | Buick Creek |
| d-52-J/94-A-11 | Mntny | 18.20 | 1510.00 | 1528.20 | 1424.50 | -85.50 | -103.70 | Buick Creek | Regional |
| b-64-I/94-A-12 | Doig | 17.88 | 1696.00 | 1713.88 | 1627.00 | -69.00 | -86.88 | Cache Creek | Cache Creek |
| d-06-A/94-A-14 | Hfwy/Doig | 28.00 | 1357.00 | 1385.00 | 1340.00 | -17.00 | -45.00 | Buick Creek | Buick Creek |
| a-26-A/94-A-14 | Doig | 22.20 | 1356.40 | 1378.60 | 1337.00 | -19.40 | -41.60 | Buick Creek | Buick Creek |
| d-35-A/94-A-14 | Hfwy/Doig | 21.70 | 1351.90 | 1373.60 | 1336.50 | -15.40 | -37.10 | Buick Creek | Buick Creek |

| UWI | Formation(s) | Core Length | Top Core | Base Core | Halfway Top | Top Core | Base Core | Area | Field |
|---|---|---|---|---|---|---|---|---|---|
| | | | (Drill Depth) | | | (Sub - Halfway) | | | |
| d-58-A/94-A-14 | Hfwy/Doig | 36.00 | 1375.00 | 1411.00 | 1362.00 | -13.00 | -49.00 | Buick Creek | Buick Creek |
| b-06-D/94-A-14 | Doig | 15.00 | 1646.00 | 1661.00 | 1580.00 | -66.00 | -81.00 | Fireweed | Fireweed |
| d-15-D/94-A-14 | Doig | 19.00 | 1635.00 | 1654.00 | 1588.50 | -46.50 | -65.50 | Fireweed | Fireweed |
| b-26-D/94-A-14 | Doig | 17.13 | 1654.00 | 1671.13 | 1601.42 | -52.58 | -69.71 | Fireweed | Fireweed |
| d-37-D/94-A-14 | Doig | 15.99 | 1623.00 | 1638.99 | 1573.00 | -50.00 | -65.99 | Fireweed | Fireweed |
| b-56-D/94-A-15 | ChLk - Hfwy | 18.20 | 1273.00 | 1291.20 | 1284.00 | 11.00 | -7.20 | Buick Creek | Regional |
| d-84-I/94-A-15 | Doig (+/- L.Hfwy?) | 25.50 | 1105.20 | 1130.70 | ? | ? | ? | Wildmint | Wildmint |
| b-10-C/94-H-01 | Doig (+/- L.Hfwy?) | 19.00 | 1106.70 | 1125.70 | 1109.60 | 2.90 | -16.10 | Wildmint | Regional |
| d-13-D/94-H-01 | Doig (+/- L.Hfwy?) | 9.00 | 1109.00 | 1118.00 | 1114.70 | 5.70 | -3.30 | Wildmint | Regional |
| | Doig (?) | 9.30 | 1128.00 | 1137.30 | 1114.70 | -13.30 | -22.60 | Wildmint | Regional |
| b-57-D/94-H-01 | Doig (+/- L.Hfwy?) | 18.70 | 1085.40 | 1104.10 | ? | ? | ? | Wildmint | Regional |
| d-15-A/94-H-02 | Doig (+/- L.Hfwy?) | 21.00 | 1118.90 | 1139.90 | ? | ? | ? | Wildmint | Wildmint |
| b-24-A/94-H-02 | Doig (+/- L.Hfwy?) | 16.10 | 1114.30 | 1130.40 | ? | ? | ? | Wildmint | Wildmint |
| d-26-A/94-H-02 | Doig (+/- L.Hfwy?) | 18.50 | 1125.00 | 1143.50 | 1125.90 | 0.90 | -17.60 | Wildmint | Wildmint |
| d-34-A/94-H-02 | Doig (+/- L.Hfwy?) | 27.30 | 1084.50 | 1111.80 | 1089.90 | 5.40 | -21.90 | Wildmint | Regional |

TOTAL: 1152.65 metres

# APPENDIX E: DOIG STUDY
# STRATIGRAPHIC TOPS FILES

# APPENDIX E1: DOIG STUDY
# STRATIGRAPHIC TOPS FILES (DLS AREA)

|  | WELL ID |  | Top Triassic |  | Halfway |  | Doig |  | Montney |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  | KB | BLDN | SS | HLFY | SS | DOIG | SS | MNTN | SS |
| • | 100/11-11-080-17W600 | 719.6 | 1569.1 | -849.5 | 1923.2 | -1203.6 | 1947.6 | -1228.0 | 2050.6 | -1331.0 |
| • | 100/08-18-080-17W600 | 759.6 | 1614.5 | -854.9 | 1986.0 | -1226.4 | 2018.0 | -1258.4 | 2127.0 | -1367.4 |
| • | 100/14-08-080-18W600 | 844.2 | 1726.0 | -881.8 | 2125.0 | -1280.8 | 2147.0 | -1302.8 |  |  |
| • | 100/13-14-080-18W600 | 734.5 | 1575.7 | -841.2 | 1955.0 | -1220.5 | 1979.0 | -1244.5 | 2109.0 | -1374.5 |
| • | 100/01-17-080-18W600 | 843.5 | 1724.0 | -880.5 | 2115.0 | -1271.5 | 2137.0 | -1293.5 |  |  |
| • | 100/07-07-080-19W600 | 870.3 | 1773.0 | -902.7 | 2221.0 | -1350.7 | 2250.5 | -1380.2 | 2406.0 | -1535.7 |
|  | 100/03-15-080-19W600 | 901.4 | 1771.7 | -870.3 | 2204.0 | -1302.6 | 2233.0 | -1331.6 |  |  |
| • | 100/16-36-080-20W600 | 919.9 | 1652.0 | -732.1 | 2090.9 | -1171.0 | 2112.3 | -1192.4 | 2286.0 | -1366.1 |
| • | 100/08-09-080-21W600 | 945.7 | 1914.0 | -968.3 | 2415.0 | -1469.3 | 2453.0 | -1507.3 |  |  |
| • | 100/07-32-080-21W600 | 472.6 | 1209.5 | -736.9 | 1706.0 | -1233.4 | 1741.0 | -1268.4 |  |  |
| • | 100/12-29-080-22W600 | 857.7 | 1694.0 | -836.3 | 2165.0 | -1307.3 | 2257.0 | -1399.3 |  |  |
| • | 100/06-01-080-23W600 | 753.0 | 1903.0 | -1150.0 | 2418.0 | -1665.0 | 2507.5 | -1754.5 |  |  |
|  | 100/10-24-081-18W600 | 771.4 | 1435.6 | -664.2 | 1783.0 | -1011.6 | 1797.0 | -1025.6 |  |  |
| • | 100/05-26-081-18W600 | 818.7 | 1466.1 | -647.4 | 1804.7 | -986.0 | 1841.9 | -1023.2 | 1956.8 | -1138.1 |
| • | 100/07-27-081-18W600 | 814.1 | 1462.1 | -648.0 | 1812.9 | -998.8 | 1830.5 | -1016.4 | 1955.5 | -1141.4 |
| • | 100/10-29-081-18W600 | 782.1 | 1421.0 | -638.9 | 1787.0 | -1004.9 | 1824.0 | -1041.9 |  |  |
| • | 100/16-30-081-18W600 | 691.3 | 1320.4 | -629.1 | 1686.7 | -995.4 | 1706.8 | -1015.5 | 1841.2 | -1149.9 |
| • | 100/06-31-081-18W600 | 704.0 | 1323.0 | -619.0 | 1686.5 | -982.5 | 1706.5 | -1002.5 |  |  |
| ? | 100/07-32-081-18W600 | 713.0 | 1351.0 | -638.0 | 1712.0 | -999.0 | 1731.0 | -1018.0 | 1863.0 | -1150.0 |
| • | 100/01-02-081-19W600 | 812.9 | 1559.0 | -746.1 | 1971.0 | -1158.1 | 1996.0 | -1183.1 | ? NDE |  |
| • | 100/14-04-081-19W600 | 865.9 | 1590.0 | -724.1 | 2009.0 | -1143.1 | 2056.0 | -1190.1 | 2192.0 | -1326.1 |
| • | 100/06-26-081-19W600 | 639.2 | 1270.1 | -630.9 | 1684.5 | -1045.3 | 1701.9 | -1062.7 |  |  |
| • | 100/04-34-081-19W600 | 793.1 | 1428.6 | -635.5 | 1822.6 | -1029.5 | 1842.7 | -1049.6 |  |  |
| • | 100/10-36-081-19W600 | 636.0 | 1265.0 | -629.0 | 1646.0 | -1010.0 | 1687.0 | -1051.0 |  |  |
|  | 100/11-22-081-20W600 | 750.0 | 1394.0 | -644.0 | 1837.0 | -1087.0 | 1872.0 | -1122.0 | 2039.0 | -1289.0 |
| • | 102/06-21-081-21W600 | 680.9 | 1284.7 | -603.8 | 1763.0 | -1082.1 |  |  |  |  |
| • | 100/13-34-081-21W600 | 685.7 | 1243.0 | -557.3 | 1682.0 | -996.3 | 1715.0 | -1029.3 | 1915.0 | -1229.3 |
| • | 100/11-22-081-22W600 | 699.0 | 1146.0 | -447.0 | 1593.5 | -894.5 | 1649.0 | -950.0 | 1881.0 | -1182.0 |
| • | 100/11-23-081-22W600 | 697.1 | 1143.0 | -445.9 | 1559.9 | -862.8 | 1606.2 | -909.1 |  |  |
| • | 100/10-19-081-23W600 | 729.4 | 1263.0 | -533.6 | 1714.0 | -984.6 | ? |  | ? |  |
| ? | 100/11-34-081-24W600 | 694.5 | 1175.0 | -480.5 | 1641.0 | -946.5 | 1700.0 | -1005.5 |  |  |
| • | 100/12-26-081-18W600 | 809.7 |  |  | 1804.0 | -994.3 | 1821.0 | -1011.3 |  |  |
| • | 100/06-02-082-19W600 | 803.1 | 1435.0 | -631.9 | 1801.0 | -997.9 | 1820.0 | -1016.9 |  |  |
| D | 100/07-05-082-19W600 | 795.0 | 1427.0 | -632.0 | 1785.0 | -990.0 | 1806.5 | -1011.5 | 1964.5 | -1169.5 |
| • | 100/05-18-082-19W600 | 636.6 | 1214.0 | -577.4 | 1606.0 | -969.4 | 1627.5 | -990.9 | 1785.0 | -1148.4 |
| • | 100/02-12-082-20W600 | 638.3 | 1217.0 | -578.7 | 1618.0 | -979.7 | 1640.0 | -1001.7 |  |  |
| • | 100/09-17-082-20W600 | 657.1 | 1161.5 | -504.4 | 1588.0 | -930.9 | 1611.0 | -953.9 | 1780.0 | -1122.9 |
|  | 100/12-19-082-20W600 | 677.2 | 1130.0 | -452.8 | 1519.0 | -841.8 | 1545.0 | -867.8 | 1720.0 | -1042.8 |
| • | 100/03-20-082-20W600 | 654.1 | 1131.7 | -477.6 | 1572.8 | -918.7 | 1594.1 | -940.0 |  |  |
| • | 100/11-26-082-20W600 | 654.9 | 1190.0 | -535.1 | 1578.0 | -923.1 | 1601.0 | -946.1 | 1743.0 | -1088.1 |
| • | 100/10-27-082-20W600 | 656.8 | 1172.0 | -515.2 | 1564.0 | -907.2 | ? |  | 1734.5 | -1077.7 |
| • | 100/11-29-082-20W600 | 665.0 | 1105.0 | -440.0 | 1496.5 | -831.5 | 1520.0 | -855.0 | 1675.0 | -1010.0 |
|  | 100/07-30-082-20W600 | 673.2 | 1105.0 | -431.8 | 1491.5 | -818.3 | 1514.0 | -840.8 | 1678.0 | -1004.8 |
| • | 102/07-30-082-20W600 | 673.0 | 1105.0 | -432.0 | 1484.0 | -811.0 | NDE |  |  |  |
| • | 100/10-34-082-20W600 | 655.8 | 1130.0 | -474.2 | 1496.5 | -840.7 | 1520.0 | -864.2 |  |  |
|  | 100/10-05-082-21W600 | 683.7 | 1031.4 | -347.7 | 1459.4 | -775.7 | 1485.6 | -801.9 |  |  |
| • | 100/07-06-082-21W600 | 673.0 | 1061.3 | -388.3 | 1470.4 | -797.4 | 1536.8 | -863.8 |  |  |
| • | 102/07-08-082-21W600 | 671.8 | 1015.6 | -343.8 | 1392.3 | -720.5 | 1443.5 | -771.7 |  |  |
| • | 100/11-09-082-21W600 | 689.2 | 1021.1 | -331.9 | 1405.1 | -715.9 | 1450.2 | -761.0 |  |  |
|  | 100/11-10-082-21W600 | 676.4 | 1153.0 | -476.6 | 1586.0 | -909.6 | 1619.0 | -942.6 |  |  |
| • | 100/14-14-082-21W600 | 680.0 | 1115.0 | -435.0 | 1497.0 | -817.0 | 1556.0 | -876.0 |  |  |
| ? | 100/05-15-082-21W600 | 674.2 | 1041.8 | -367.6 | 1435.0 | -760.8 | 1463.0 | -788.8 | 1645.3 | -971.1 |
| • | 100/14-15-082-21W600 | 672.1 | 1033.9 | -361.8 | 1405.1 | -733.0 | 1433.8 | -761.7 | 1613.6 | -941.5 |
| • | 100/06-16-082-21W600 | 668.1 | 1032.1 | -364.0 | 1439.9 | -771.8 | 1473.4 | -805.3 |  |  |

| WELL ID | Base Triassic | | 1st Doig Sand | | Thickness | | 2nd Doig Sand | | Thickness | |
|---|---|---|---|---|---|---|---|---|---|---|
| | BLLY | SS | 1st Sand | SS | Sand | Silt Eq. | 2nd Sand | SS | Sand | Silt Eq. |
| 100/11-11-080-17W600 | 2386.3 | -1666.7 | 1965.9 | -1246.3 | ? 2.1 | 4.9 | | | | |
| 100/08-18-080-17W600 | | | 2060.0 | -1300.4 | 18.5 | 25.0 | | | | |
| 100/14-08-080-18W600 | | | 2182.0 | -1337.8 | 4.5 | ? | ?NDE | | | |
| 100/13-14-080-18W600 | 2433.0 | -1698.5 | 2004.5 | -1270.0 | 16.0 | 19.5 | NP | | 0.0 | 0.0 |
| 100/01-17-080-18W600 | | | 2183.0 | -1339.5 | 29.0 | 31.0 | | | | |
| 100/07-07-080-19W600 | | | 2289.0 | -1418.7 | 0.0 | 4.0 | NP | | 0.0 | 0.0 |
| 100/03-15-080-19W600 | | | 2251.0 | -1349.6 | 0.0 | ? 5 | | | | |
| 100/16-36-080-20W600 | 2584.7 | -1664.8 | | | | | | | | |
| 100/08-09-080-21W600 | | | 2473.0 | -1527.3 | 4.0 | 6.0 | 2499.0 | -1553.3 | 35.0 | 35.0 |
| 100/07-32-080-21W600 | 2195.0 | -1722.4 | | | | | 1781.5 | -1308.9 | 35.0 | 35.0 |
| 100/12-29-080-22W600 | 2753.0 | -1895.3 | ?NDE | | | | NDE | | | |
| 100/06-01-080-23W600 | | | | | | | NDE | | | |
| 100/10-24-081-18W600 | | | 1833.6 | -1062.2 | ? 7.3 | 7.3 | NDE | | | |
| 100/05-26-081-18W600 | 2268.9 | -1450.2 | | | | | | | | |
| 100/07-27-081-18W600 | 2269.2 | -1455.1 | 1856.1 | -1042.0 | ? 4.0 | 4.0 | | | | |
| 100/10-29-081-18W600 | | | NDE | | | | NDE | | | |
| 100/16-30-081-18W600 | 2144.6 | -1453.3 | 1728.1 | -1036.8 | 3.1 | 3.1 | ? | | | |
| 100/06-31-081-18W600 | | | 1749.0 | -1045.0 | > 4.0 | NDE | NDE | | | |
| 100/07-32-081-18W600 | | | 1769.0 | -1056.0 | 0.0 | 19.0 | | | | |
| 100/01-02-081-19W600 | | | 2028.0 | -1215.1 | trace | 27.0 | | | | |
| 100/14-04-081-19W600 | 2495.0 | -1629.1 | NP | | 0.0 | 0.0 | NP | | 0.0 | 0.0 |
| 100/06-26-081-19W600 | | | 1737.3 | -1098.1 | 12.8 | 12.8 | | | | |
| 100/04-34-081-19W600 | | | NDE | | | | NDE | | | |
| 100/10-36-081-19W600 | | | NDE | | | | NDE | | | |
| 100/11-22-081-20W600 | 2320.0 | -1570.0 | NP | | 0.0 | 0.0 | NP | | 0.0 | 0.0 |
| 102/06-21-081-21W600 | | | | | | | | | | |
| 100/13-34-081-21W600 | 2173.0 | -1487.3 | 1749.0 | -1063.3 | 0.0 | FS | ? | | | |
| 100/11-22-081-22W600 | 2082.0 | -1383.0 | NP | | 0.0 | 0.0 | NP | | 0.0 | 0.0 |
| 100/11-23-081-22W600 | | | NDE | | | | NDE | | | |
| 100/10-19-081-23W600 | ? | | NDE | | | | NDE | | | |
| 100/11-34-081-24W600 | | | NDE | | | | NDE | | | |
| 100/12-26-081-18W600 | | | ?NDE | | | | NDE | | | |
| 100/06-02-082-19W600 | | | NDE | | | | NDE | | | |
| 100/07-05-082-19W600 | 2252.0 | -1457.0 | 1839.0 | -1044.0 | ? 41m | 44.0 | ? NP | | 0.0 | |
| 100/05-18-082-19W600 | 2190.5 | -1553.9 | 1660.0 | -1023.4 | 16.0 | 24.0 | | | | |
| 100/02-12-082-20W600 | | | 1675.0 | -1036.7 | ? 6m | 15.5 | | | | |
| 100/09-17-082-20W600 | 2047.0 | -1389.9 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/12-19-082-20W600 | 1966.5 | -1289.3 | 1579.0 | -901.8 | 6.0 | 6.0 | ? NP | | 0.0 | |
| 100/03-20-082-20W600 | | | | | 0.0 | | | | | |
| 100/11-26-082-20W600 | 2027.0 | -1372.1 | 1624.0 | -969.1 | 6.0 | 6.0 | ? NP | | 0.0 | |
| 100/10-27-082-20W600 | 2012.5 | -1355.7 | 1620.0 | -963.2 | ?6.0 | 61.0 | ? NP | | 0.0 | |
| 100/11-29-082-20W600 | 1947.0 | -1282.0 | 1564.0 | -899.0 | 4.0 | ?14.0 | | | | |
| 100/07-30-082-20W600 | 1944.0 | -1270.8 | 1551.0 | -877.8 | 19.0 | 21.0 | | | | |
| 102/07-30-082-20W600 | | | | | | | | | | |
| 100/10-34-082-20W600 | | | NDE | | | | NDE | | | |
| 100/10-05-082-21W600 | | | NDE | | | | NDE | | | |
| 100/07-06-082-21W600 | | | NDE | | | | NDE | | | |
| 102/07-08-082-21W600 | | | NDE | | | | NDE | | | |
| 100/11-09-082-21W600 | | | ? NDE | | | | NDE | | | |
| 100/11-10-082-21W600 | | | NDE | | | | NDE | | | |
| 100/14-14-082-21W600 | | | NDE | | | | NDE | | | |
| 100/05-15-082-21W600 | 1886.7 | -1212.5 | ? NP | | 0.0 | | NP | | 0.0 | 0.0 |
| 100/14-15-082-21W600 | 1854.1 | -1182.0 | NP | | 0.0 | 0.0 | NP | | 0.0 | 0.0 |
| 100/06-16-082-21W600 | | | NP | | 0.0 | 0.0 | NP | | 0.0 | 0.0 |

| WELL ID | DOIG<br>GAS | DOIG<br>OIL | CORE | COMMENTS |
|---|---|---|---|---|
| 100/11-11-080-17W600 | | | | top 1st Doig sand = FS |
| 100/08-18-080-17W600 | | | D | 1st Doig sand = 2 disturbed sands (50.m,13.5m) |
| 100/14-08-080-18W600 | | | | |
| 100/13-14-080-18W600 | | | | |
| 100/01-17-080-18W600 | | | | |
| 100/07-07-080-19W600 | | | | |
| 100/03-15-080-19W600 | | | | FS at 2280 |
| 100/16-36-080-20W600 | | | | e-log |
| 100/08-09-080-21W600 | | ? | D | |
| 100/07-32-080-21W600 | | | | 1st and 2nd sands amalgamated? |
| 100/12-29-080-22W600 | ? | | | |
| 100/06-01-080-23W600 | | | | |
| 100/10-24-081-18W600 | | | | 1st Doig sand: 7.3m offscale gamma response at end of logging run |
| 100/05-26-081-18W600 | | | | e-log |
| 100/07-27-081-18W600 | | | | Upper sand= 2 sands |
| 100/10-29-081-18W600 | | | | |
| 100/16-30-081-18W600 | | | | 1781.9 - 0.9m silt; 1795.9 - 0.6m silt; 1829.4 - 6.1m silt |
| 100/06-31-081-18W600 | | | | 1734 - FS; 1740 - FS |
| 100/07-32-081-18W600 | | | | Additional Sand eqv. at 1855m |
| 100/01-02-081-19W600 | | | | 7.5m silty sand at 2116.5m |
| 100/14-04-081-19W600 | | | | |
| 100/06-26-081-19W600 | | | | 1st Doig sand - 12.8m offscale gamma response, 7.0m silt /fs at 1726.6m |
| 100/04-34-081-19W600 | | | | |
| 100/10-36-081-19W600 | | | | |
| 100/11-22-081-20W600 | | | | |
| 102/06-21-081-21W600 | | | | no fiche |
| 100/13-34-081-21W600 | | | | 1749 - FS |
| 100/11-22-081-22W600 | | | | |
| 100/11-23-081-22W600 | | | | |
| 100/10-19-081-23W600 | | | | |
| 100/11-34-081-24W600 | | | | |
| 100/12-26-081-18W600 | | | | not in original database |
| 100/06-02-082-19W600 | | | | |
| 100/07-05-082-19W600 | | | | |
| 100/05-18-082-19W600 | | | | 1st Doig = 2 distinct sands each 8m thick |
| 100/02-12-082-20W600 | | | | |
| 100/09-17-082-20W600 | | | | |
| 100/12-19-082-20W600 | | | | |
| 100/03-20-082-20W600 | | | | e-log |
| 100/11-26-082-20W600 | | | | |
| 100/10-27-082-20W600 | | | | silts at 1620, 1651, 1661, 1722: DOIG at 1584.5 or 1592.0 |
| 100/11-29-082-20W600 | | | | silt at 1665 (4m) ; silt at 1545 (7m) base 1st doig eqv. |
| 100/07-30-082-20W600 | X | | | silt at 1666.5 (7m) : additional sand at 1590 (4m) in 15 m coarsening up |
| 102/07-30-082-20W600 | | | | |
| 100/10-34-082-20W600 | | | | DOIG at 1520.0m or 1528.0m |
| 100/10-05-082-21W600 | | | | |
| 100/07-06-082-21W600 | | | | |
| 102/07-08-082-21W600 | | | | 02 well? or 00 well? |
| 100/11-09-082-21W600 | | | | HFWY at 1419.1? |
| 100/11-10-082-21W600 | | | | |
| 100/14-14-082-21W600 | | | | |
| 100/05-15-082-21W600 | | | | silt at 1602 (5.5m) |
| 100/14-15-082-21W600 | | | | |
| 100/06-16-082-21W600 | | | | |

| | WELL ID | | Top Triassic | | Halfway | | Doig | | Montney | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | KB | BLDN | SS | HLFY | SS | DOIG | SS | MNTN | SS |
| | 100/07-17-082-21W600 | 659.5 | 1065.0 | -405.5 | 1483.0 | -823.5 | 1515.0 | -855.5 | 1709.0 | -1049.5 |
| • | 100/10-19-082-21W600 | 637.0 | 1057.0 | -420.0 | 1469.0 | -832.0 | 1532.0 | -895.0 | | |
| • | 100/07-21-082-21W600 | 656.0 | 1109.0 | -453.0 | 1486.0 | -830.0 | 1520.0 | -864.0 | 1703.0 | -1047.0 |
| | 100/06-22-082-21W600 | 665.4 | 1051.0 | -385.6 | 1416.1 | -750.7 | 1452.1 | -786.7 | | |
| • | 100/06-23-082-21W600 | 675.1 | 1019.9 | -344.8 | 1377.7 | -702.6 | 1432.6 | -757.5 | | |
| | 100/11-24-082-21W600 | 680.0 | 1125.5 | -445.5 | 1505.0 | -825.0 | 1527.5 | -847.5 | | |
| • | 100/06-25-082-21W600 | 655.9 | 1109.0 | -453.1 | 1473.0 | -817.1 | 1516.0 | -860.1 | | |
| • | 100/06-26-082-21W600 | 700.1 | 1057.4 | -357.3 | 1433.2 | -733.1 | 1460.6 | -760.5 | | |
| • | 100/11-26-082-21W600 | 640.9 | 1064.5 | -423.6 | 1446.0 | -805.1 | 1473.5 | -832.6 | 1635.0 | -994.1 |
| • | 100/07-27-082-21W600 | 638.9 | 1059.0 | -420.1 | 1436.0 | -797.1 | 1465.0 | -826.1 | 1631.0 | -992.1 |
| • | 100/15-28-082-21W600 | 640.2 | 1070.5 | -430.3 | 1466.0 | -825.8 | 1494.0 | -853.8 | | |
| • | 100/10-29-082-21W600 | 633.7 | 1044.5 | -410.8 | 1458.0 | -824.3 | 1485.5 | -851.8 | | |
| • | 100/09-33-082-21W600 | 633.9 | 1059.0 | -425.1 | 1448.0 | -814.1 | 1472.0 | -838.1 | | |
| • | 100/07-34-082-21W600 | 638.8 | 1066.0 | -427.2 | 1458.5 | -819.7 | 1486.5 | -847.7 | | |
| • | 100/11-35-082-21W600 | 636.6 | 1068.5 | -431.9 | 1461.5 | -824.9 | 1485.0 | -848.4 | 1535.0 | -898.4 |
| • | 100/07-02-082-22W600 | 667.2 | 1096.0 | -428.8 | 1521.5 | -854.3 | 1583.5 | -916.3 | 1782.0 | -1114.8 |
| • | 100/10-15-082-22W600 | 657.5 | 1049.4 | -391.9 | 1480.1 | -822.6 | 1534.4 | -876.9 | | |
| • | 100/06-17-082-22W600 | 670.6 | 1074.0 | -403.4 | 1520.0 | -849.4 | 1561.5 | -890.9 | | |
| | 100/11-20-082-22W600 | 655.3 | 1048.0 | -392.7 | 1481.0 | -825.7 | 1549.0 | -893.7 | | |
| • | 100/04-23-082-22W600 | 668.4 | 1058.0 | -389.6 | 1487.4 | -819.0 | 1540.8 | -872.4 | | |
| • | 100/10-23-082-22W600 | 660.8 | 1054.6 | -393.8 | 1486.2 | -825.4 | ? | | | |
| • | 100/11-28-082-22W600 | 660.0 | 1044.5 | -384.5 | 1476.0 | -816.0 | 1537.0 | -877.0 | | |
| • | 100/07-31-082-22W600 | 684.6 | 1090.0 | -405.4 | 1517.0 | -832.4 | NDE | | | |
| • | 100/01-32-082-22W600 | 695.0 | 1077.0 | -382.0 | 1503.0 | -808.0 | NDE | | | |
| • | 100/07-33-082-22W600 | 660.8 | 1037.5 | -376.7 | 1463.0 | -802.2 | 1519.0 | -858.2 | | |
| • | 100/06-34-082-22W600 | 657.5 | 1032.0 | -374.5 | 1457.0 | -799.5 | 1509.0 | -851.5 | | |
| • | 100/11-35-082-22W600 | 661.4 | 1029.0 | -367.6 | 1450.0 | -788.6 | 1502.0 | -840.6 | | |
| • | 100/06-02-082-23W600 | 735.0 | 1155.0 | -420.0 | 1584.0 | -849.0 | 1655.0 | -920.0 | 1900.0 | -1165.0 |
| • | 100/06-05-082-23W600 | 692.4 | 1161.0 | -468.6 | 1606.0 | -913.6 | 1691.0 | -998.6 | 1960.0 | -1267.6 |
| • | 100/07-06-082-23W600 | 717.9 | 1184.0 | -466.1 | 1634.0 | -916.1 | 1728.0 | -1010.1 | 1984.0 | -1266.1 |
| • | 100/08-26-082-23W600 | 669.0 | 1084.8 | -415.8 | 1509.4 | -840.4 | 1573.1 | -904.1 | | |
| • | 100/10-27-082-23W600 | 668.5 | 1072.0 | -403.5 | 1502.5 | -834.0 | 1572.0 | -903.5 | 1790.0 | -1121.5 |
| • | 100/06-03-082-24W600 | 677.0 | 1154.0 | -477.0 | 1615.0 | -938.0 | 1673.0 | -996.0 | 1993.0 | -1316.0 |
| • | 100/10-01-082-25W600 | 667.2 | 1137.5 | -470.3 | 1647.4 | -980.2 | 1703.8 | -1036.6 | 1890.1 | -1222.9 |
| • | 100/06-05-083-19W600 | 646.2 | 1172.6 | -526.4 | 1534.4 | -888.2 | 1555.1 | -908.9 | 1679.4 | -1033.2 |
| • | 100/10-10-083-19W600 | 479.5 | 987.9 | -508.4 | 1340.5 | -861.0 | 1358.8 | -879.3 | 1478.6 | -999.1 |
| • | 100/07-12-083-19W600 | 478.0 | 988.0 | -510.0 | 1336.0 | -858.0 | 1353.5 | -875.5 | 1467.0 | -989.0 |
| • | 100/11-17-083-19W600 | 635.5 | 1115.6 | -480.1 | 1463.0 | -827.5 | 1481.3 | -845.8 | 1595.0 | -959.5 |
| • | 100/10-18-083-19W600 | 642.2 | 1102.5 | -460.3 | 1448.5 | -806.3 | 1466.0 | -823.8 | 1588.0 | -945.8 |
| • | 100/08-19-083-19W600 | 642.4 | 1103.0 | -460.6 | 1451.0 | -808.6 | 1472.0 | -829.6 | | |
| • | 100/10-19-083-19W600 | 643.1 | 1107.3 | -464.2 | 1458.8 | -815.7 | 1476.5 | -833.4 | 1585.0 | -941.9 |
| | 100/11-20-083-19W600 | 642.5 | 1108.9 | -466.4 | 1450.8 | -808.3 | 1469.1 | -826.6 | ? | |
| | 100/07-24-083-19W600 | 628.8 | 1133.9 | -505.1 | 1467.3 | -838.5 | 1487.4 | -858.6 | 1591.1 | -962.3 |
| • | 100/07-25-083-19W600 | 655.6 | 1150.3 | -494.7 | 1481.3 | -825.7 | 1499.6 | -844.0 | 1613.6 | -958.0 |
| • | 100/11-26-083-19W600 | 660.2 | 1136.0 | -475.8 | 1470.0 | -809.8 | 1494.0 | -833.8 | | |
| • | 100/10-27-083-19W600 | 644.7 | 1124.1 | -479.4 | 1460.0 | -815.3 | 1480.1 | -835.4 | | |
| D | 100/07-28-083-19W600 | 655.9 | 1138.4 | -482.5 | 1479.2 | -823.3 | 1497.2 | -841.3 | 1633.7 | -977.8 |
| • | 102/07-28-083-19W600 | 656.5 | 1160.5 | -504.0 | ? NDE | | | | | |
| • | 100/07-30-083-19W600 | 517.9 | 983.9 | -466.0 | 1329.2 | -811.3 | 1347.2 | -829.3 | 1456.3 | -938.4 |
| • | 100/10-31-083-19W600 | 660.8 | 1147.9 | -487.1 | 1488.6 | -827.8 | 1503.3 | -842.5 | | |
| • | 100/10-32-083-19W600 | 663.5 | 1148.8 | -485.3 | 1487.4 | -823.9 | 1501.4 | -837.9 | | |
| ? | 100/11-34-083-19W600 | 661.4 | 1147.0 | -485.6 | 1472.8 | -811.4 | 1494.1 | -832.7 | | |
| • | 100/13-34-083-19W600 | 681.2 | 1166.5 | -485.3 | ? | | ? | | ? | |
| • | 100/10-02-083-20W600 | 652.1 | 1133.0 | -480.9 | 1493.5 | -841.4 | 1513.0 | -860.9 | | |

| WELL ID | Base Triassic | | 1st Doig Sand | | Thickness | | 2nd Doig Sand | | Thickness | |
|---|---|---|---|---|---|---|---|---|---|---|
| | BLLY | SS | 1st Sand | SS | Sand | Silt Eq. | 2nd Sand | SS | Sand | Silt Eq. |
| 100/07-17-082-21W600 | 1946.5 | -1287.0 | | | | | | | | |
| 100/10-19-082-21W600 | | | NDE | | | | NDE | | | |
| 100/07-21-082-21W600 | 1960.0 | -1304.0 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/06-22-082-21W600 | | | NDE | | | | NDE | | | |
| 100/06-23-082-21W600 | | | NDE | | | | NDE | | | |
| 100/11-24-082-21W600 | | | NDE | | | | NDE | | | |
| 100/06-25-082-21W600 | | | | | | | | | | |
| 100/06-26-082-21W600 | | | NDE | | | | NDE | | | |
| 100/11-26-082-21W600 | 1905.5 | -1264.6 | ? NP | | 0.0 | | 1616.5 | -975.6 | 0.0 | 11.0 |
| 100/07-27-082-21W600 | 1896.5 | -1257.6 | ?NP | | | 0.0 | 1585.0 | -946.1 | 5.0 | 40.0 |
| 100/15-28-082-21W600 | | | NDE | | | | NDE | | | |
| 100/10-29-082-21W600 | | | 1505.0 | -871.3 | 1.5 | 4.0 | | | | |
| 100/09-33-082-21W600 | | | NDE | | | | NDE | | | |
| 100/07-34-082-21W600 | | | NDE | | | | NDE | | | |
| 100/11-35-082-21W600 | | | 1507.0 | -870.4 | 1.5 | 5.0 | ? NP | | 0.0 | |
| 100/07-02-082-22W600 | 2007.0 | -1339.8 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/10-15-082-22W600 | | | NDE | | | | NDE | | | |
| 100/06-17-082-22W600 | 1989.0 | -1318.4 | ? | | | | ? | | | |
| 100/11-20-082-22W600 | | | ? NDE | | | | NDE | | | |
| 100/04-23-082-22W600 | | | NDE | | | | NDE | | | |
| 100/10-23-082-22W600 | | | NDE | | | | NDE | | | |
| 100/11-28-082-22W600 | | | NDE | | | | NDE | | | |
| 100/07-31-082-22W600 | | | NDE | | | | NDE | | | |
| 100/01-32-082-22W600 | | | NDE | | | | NDE | | | |
| 100/07-33-082-22W600 | | | NDE | | | | NDE | | | |
| 100/06-34-082-22W600 | | | ? NDE | | | | NDE | | | |
| 100/11-35-082-22W600 | | | NDE | | | | NDE | | | |
| 100/06-02-082-23W600 | 2114.0 | -1379.0 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/06-05-082-23W600 | 2132.0 | -1439.6 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/07-06-082-23W600 | 2152.0 | -1434.1 | | | | | 1769.0 | -1051.1 | 6.0 | |
| 100/08-26-082-23W600 | | | NDE | | | | NDE | | | |
| 100/10-27-082-23W600 | 2027.0 | -1358.5 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/06-03-082-24W600 | 2163.5 | -1486.5 | NP | | 0.0 | 0.0 | ? NP | | 0.0 | |
| 100/10-01-082-25W600 | 2194.3 | -1527.1 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/06-05-083-19W600 | 1993.4 | -1347.2 | 1605.6 | -959.4 | 12.5 | | ? NP | | 0.0 | |
| 100/10-10-083-19W600 | 1795.3 | -1315.8 | 1424.6 | -945.1 | 7.9 | | ? NP | | 0.0 | |
| 100/07-12-083-19W600 | 1796.0 | -1318.0 | 1415.0 | -937.0 | 0.0 | 1.0 | ? NP | | 0.0 | |
| 100/11-17-083-19W600 | 1917.2 | -1281.7 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/10-18-083-19W600 | 1910.0 | -1267.8 | 1487.0 | -844.8 | 10? | 49.5 | ? NP | | 0.0 | |
| 100/08-19-083-19W600 | | | ? NDE | | | | | | | |
| 100/10-19-083-19W600 | 1902.0 | -1258.9 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/11-20-083-19W600 | 1892.5 | -1250.0 | | | | | | | | |
| 100/07-24-083-19W600 | 1919.9 | -1291.1 | | | | | | | | |
| 100/07-25-083-19W600 | 1932.4 | -1276.8 | | | | | | | | |
| 100/11-26-083-19W600 | | | ? NDE | | | | | | | |
| 100/10-27-083-19W600 | | | NDE | | | | | | | |
| 100/07-28-083-19W600 | 1921.2 | -1265.3 | 1517.8 | -861.9 | ? 3.7 | 3.7 | ? 1538.6 | -882.7 | ? | |
| 102/07-28-083-19W600 | | | | | | | | | | |
| 100/07-30-083-19W600 | 1771.5 | -1253.6 | 1374.6 | -856.7 | ? 4.2 | 4.2 | ? NP | | 0.0 | |
| 100/10-31-083-19W600 | | | NDE | | | | | | | |
| 100/10-32-083-19W600 | | | 1532.5 | -869.0 | 2.4 | | NDE | | | |
| 100/11-34-083-19W600 | | | | | | | | | | |
| 100/13-34-083-19W600 | 1933.3 | -1252.1 | | | | | | | | |
| 100/10-02-083-20W600 | | | ? 1543 | -890.9 | >2.0 | | NDE | | | |

| WELL ID | DOIG | DOIG | CORE | COMMENTS |
|---|---|---|---|---|
|  | GAS | OIL |  |  |
| 100/07-17-082-21W600 |  |  |  |  |
| 100/10-19-082-21W600 |  |  |  |  |
| 100/07-21-082-21W600 |  |  |  |  |
| 100/06-22-082-21W600 |  |  |  |  |
| 100/06-23-082-21W600 |  |  |  |  |
| 100/11-24-082-21W600 |  |  |  |  |
| 100/06-25-082-21W600 |  |  |  |  |
| 100/06-26-082-21W600 |  |  |  |  |
| 100/11-26-082-21W600 |  |  |  | silt at 1616.5 (11m): = 2nd Doig Sand Eq? |
| 100/07-27-082-21W600 |  |  |  | 1500 - FS(1st doig eqv.); 1585 - TSE?; 1620 - TSE? |
| 100/15-28-082-21W600 |  |  |  |  |
| 100/10-29-082-21W600 |  |  |  |  |
| 100/09-33-082-21W600 |  |  |  |  |
| 100/07-34-082-21W600 |  |  |  |  |
| 100/11-35-082-21W600 |  |  |  | MNTNY pick questionable |
| 100/07-02-082-22W600 |  |  |  | 1631 - FS |
| 100/10-15-082-22W600 |  |  |  |  |
| 100/06-17-082-22W600 |  |  |  | 1584 - FS |
| 100/11-20-082-22W600 |  |  |  |  |
| 100/04-23-082-22W600 |  |  |  |  |
| 100/10-23-082-22W600 |  |  |  | Doig at 1527.0m or 1530.7m |
| 100/11-28-082-22W600 |  |  |  |  |
| 100/07-31-082-22W600 |  |  |  |  |
| 100/01-32-082-22W600 |  |  |  |  |
| 100/07-33-082-22W600 |  |  |  |  |
| 100/06-34-082-22W600 |  |  |  |  |
| 100/11-35-082-22W600 |  |  |  |  |
| 100/06-02-082-23W600 |  |  |  | MNTNY pick not checked |
| 100/06-05-082-23W600 |  |  |  | MNTNY pick not checked; DOIG at 1700m? |
| 100/07-06-082-23W600 |  |  |  | MNTNY pick not checked |
| 100/08-26-082-23W600 |  |  |  |  |
| 100/10-27-082-23W600 |  |  |  |  |
| 100/06-03-082-24W600 |  |  |  | MNTNY pick not checked |
| 100/10-01-082-25W600 |  |  |  | e-log |
| 100/06-05-083-19W600 |  |  |  |  |
| 100/10-10-083-19W600 |  |  |  |  |
| 100/07-12-083-19W600 |  |  |  |  |
| 100/11-17-083-19W600 |  |  |  | no detail gamma ray log run through DOIG - MNTNY interval |
| 100/10-18-083-19W600 |  |  |  | FS at 1550m : Questionable gamma correlation (sand Cut-off at 45 API) |
| 100/08-19-083-19W600 |  |  |  |  |
| 100/10-19-083-19W600 |  |  |  |  |
| 100/11-20-083-19W600 |  |  |  |  |
| 100/07-24-083-19W600 |  |  |  | e-log |
| 100/07-25-083-19W600 |  |  |  | e-log |
| 100/11-26-083-19W600 |  |  |  |  |
| 100/10-27-083-19W600 |  |  |  |  |
| 100/07-28-083-19W600 |  |  |  |  |
| 102/07-28-083-19W600 |  |  |  |  |
| 100/07-30-083-19W600 |  |  |  |  |
| 100/10-31-083-19W600 |  |  |  |  |
| 100/10-32-083-19W600 |  |  |  |  |
| 100/11-34-083-19W600 |  |  |  |  |
| 100/13-34-083-19W600 |  |  |  |  |
| 100/10-02-083-20W600 | X |  |  | Sand at base log coverage |

| | WELL ID | | Top Triassic | | Halfway | | Doig | | Montney | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | KB | BLDN | SS | HLFY | SS | DOIG | SS | MNTN | SS |
| • | 100/06-05-083-20W600 | 645.9 | 1116.2 | -470.3 | 1501.4 | -855.5 | 1521.0 | -875.1 | | |
| D | 100/06-06-083-20W600 | 635.8 | 1074.4 | -438.6 | 1463.0 | -827.2 | 1483.2 | -847.4 | | |
| • | 100/06-07-083-20W600 | 634.6 | 1191.5 | -556.9 | 1451.9 | -817.3 | dev. | | | |
| • | 100/06-10-083-20W600 | 637.0 | 1116.0 | -479.0 | 1495.0 | -858.0 | 1516.0 | -879.0 | | |
| • | 100/10-12-083-20W600 | 648.6 | 1121.5 | -472.9 | 1480.0 | -831.4 | 1499.0 | -850.4 | 1627.0 | -978.4 |
| • | 100/08-13-083-20W600 | 640.0 | 1101.0 | -461.0 | 1457.5 | -817.5 | 1477.0 | -837.0 | | |
| • | 100/10-14-083-20W600 | 641.9 | 1111.0 | -469.1 | 1477.7 | -835.8 | 1493.5 | -851.6 | ? | |
| • | 100/11-16-083-20W600 | 638.6 | 1088.4 | -449.8 | 1466.1 | -827.5 | 1486.2 | -847.6 | | |
| • | 100/11-18-083-20W600 | 633.0 | 1076.0 | -443.0 | 1474.0 | -841.0 | 1500.0 | -867.0 | | |
| • | 100/11-19-083-20W600 | 639.6 | 1088.0 | -448.4 | 1481.0 | -841.4 | 1501.0 | -861.4 | | |
| • | 100/06-22-083-20W600 | 487.7 | 944.9 | -457.2 | 1318.0 | -830.3 | NDE | | | |
| • | 100/11-28-083-20W600 | 470.3 | 949.5 | -479.2 | 1343.0 | -872.7 | 1362.0 | -891.7 | | |
| • | 100/09-33-083-20W600 | 635.2 | 1092.1 | -456.9 | 1454.8 | -819.6 | 1478.3 | -843.1 | 1576.4 | -941.2 |
| • | 100/06-35-083-20W600 | 644.3 | 1113.7 | -469.4 | 1466.7 | -822.4 | 1481.9 | -837.6 | | |
| • | 100/10-01-083-21W600 | 623.6 | 1050.0 | -426.4 | 1444.0 | -820.4 | 1466.5 | -842.9 | | |
| • | 100/10-02-083-21W600 | 626.2 | 1037.0 | -410.8 | 1439.0 | -812.8 | 1467.0 | -840.8 | | |
| • | 100/10-03-083-21W600 | 654.1 | 1054.3 | -400.2 | 1464.8 | -810.7 | 1490.1 | -836.0 | | |
| • | 100/10-04-083-21W600 | 654.7 | 1040.0 | -385.3 | 1458.0 | -803.3 | 1483.0 | -828.3 | 1634.0 | -979.3 |
| • | 100/14-05-083-21W600 | 656.8 | 1040.0 | -383.2 | 1458.0 | -801.2 | 1487.0 | -830.2 | | |
| • | 100/10-06-083-21W600 | 661.7 | 1043.0 | -381.3 | 1470.0 | -808.3 | 1495.0 | -833.3 | | |
| • | 100/07-07-083-21W600 | 658.7 | 1042.0 | -383.3 | 1464.5 | -805.8 | 1490.0 | -831.3 | | |
| • | 100/07-08-083-21W600 | 660.3 | 1050.0 | -389.7 | 1464.0 | -803.7 | 1490.0 | -829.7 | | |
| • | 100/06-10-083-21W600 | 662.9 | 1051.6 | -388.7 | 1459.3 | -796.4 | 1484.3 | -821.4 | | |
| • | 100/10-10-083-21W600 | 655.0 | 1045.0 | -390.0 | 1447.0 | -792.0 | 1465.0 | -810.0 | | |
| • | 100/10-11-083-21W600 | 636.3 | 1048.0 | -411.7 | 1441.0 | -804.7 | 1463.0 | -826.7 | | |
| • | 100/14-12-083-21W600 | 628.9 | 1056.5 | -427.6 | 1459.0 | -830.1 | 1493.5 | -864.6 | | |
| • | 100/11-13-083-21W600 | 635.5 | 1062.5 | -427.0 | 1444.5 | -809.0 | 1471.0 | -835.5 | | |
| • | 100/10-14-083-21W600 | 638.6 | 1045.0 | -406.4 | 1430.0 | -791.4 | 1459.5 | -820.9 | | |
| • | 100/10-15-083-21W600 | 642.2 | 1034.0 | -391.8 | 1425.0 | -782.8 | 1446.5 | -804.3 | | |
| • | 100/07-16-083-21W600 | 663.9 | 1050.0 | -386.1 | 1459.0 | -795.1 | 1483.0 | -819.1 | | |
| • | 100/11-19-083-21W600 | 662.7 | 1080.0 | -417.3 | 1492.0 | -829.3 | 1515.0 | -852.3 | | |
| • | 100/06-21-083-21W600 | 646.3 | 1045.0 | -398.7 | 1440.0 | -793.7 | 1462.0 | -815.7 | | |
| • | 100/10-22-083-21W600 | 636.7 | 1044.0 | -407.3 | 1422.0 | -785.3 | 1442.0 | -805.3 | | |
| • | 100/10-23-083-21W600 | 632.3 | 1055.0 | -422.7 | 1433.0 | -800.7 | 1457.0 | -824.7 | | |
| • | 102/11-24-083-21W600 | 633.8 | 1075.0 | -441.2 | 1454.0 | -820.2 | 1478.0 | -844.2 | 1585.0 | -951.2 |
| • | 100/06-26-083-21W600 | 633.8 | 1108.0 | -474.2 | ? | | 1512.5 | -878.7 | | |
| • | 100/10-29-083-21W600 | 636.2 | 1038.0 | -401.8 | 1428.5 | -792.3 | 1448.0 | -811.8 | | |
| | 100/07-33-083-21W600 | 626.9 | 1050.5 | -423.6 | 1416.0 | -789.1 | 1437.0 | -810.1 | | |
| • | 100/04-34-083-21W600 | 628.8 | 1071.1 | -442.3 | 1430.1 | -801.3 | 1450.5 | -821.7 | 1555.9 | -927.1 |
| • | 100/06-36-083-21W600 | 623.3 | 1085.0 | -461.7 | 1461.0 | -837.7 | 1484.0 | -860.7 | | |
| • | 100/06-02-083-22W600 | 658.0 | 1034.5 | -376.5 | 1455.5 | -797.5 | 1504.0 | -846.0 | | |
| ? | 100/07-03-083-22W600 | 666.0 | 1050.0 | -384.0 | 1469.0 | -803.0 | 1520.0 | -854.0 | | |
| | 100/06-09-083-22W600 | 674.5 | 1099.7 | -425.2 | 1524.5 | -850.0 | 1579.4 | -904.9 | | |
| ? | 100/01-27-083-22W600 | 661.6 | 1136.0 | -474.4 | 1537.0 | -875.4 | 1610.0 | -948.4 | | |
| • | 100/06-21-083-23W600 | 652.9 | 1164.5 | -511.6 | 1556.0 | -903.1 | 1607.0 | -954.1 | | |
| • | 100/12-11-083-24W600 | 657.5 | 1212.5 | -555.0 | 1624.5 | -967.0 | NDE | | | |
| • | 100/06-17-083-24W600 | 674.0 | 1225.0 | -551.0 | 1651.0 | -977.0 | 1730.0 | -1056.0 | 1941.0 | -1267.0 |
| | 100/10-36-083-25W600 | 715.3 | 1335.5 | -620.2 | 1783.0 | -1067.7 | 1815.0 | -1099.7 | 2015.0 | -1299.7 |
| • | 100/11-07-084-19W600 | 735.8 | 1248.0 | -512.2 | 1558.0 | -822.2 | 1582.0 | -846.2 | | |
| • | 100/06-13-084-19W600 | 718.7 | 1212.5 | -493.8 | 1498.1 | -779.4 | 1531.6 | -812.9 | 1607.5 | -888.8 |
| | 100/02-18-084-19W600 | 762.0 | 1257.9 | -495.9 | 1575.8 | -813.8 | 1606.3 | -844.3 | 1686.5 | -924.5 |
| | 100/11-21-084-19W600 | 729.4 | 1216.2 | -486.8 | 1513.3 | -783.9 | 1543.8 | -814.4 | 1615.4 | -886.0 |
| | 100/13-01-084-20W600 | 818.7 | 1317.0 | -498.3 | 1631.0 | -812.3 | 1664.2 | -845.5 | 1751.7 | -933.0 |
| • | 100/07-02-084-20W600 | 755.0 | 1228.3 | -473.3 | 1564.9 | -809.9 | 1581.9 | -826.9 | | |

| WELL ID | Base Triassic |  | 1st Doig Sand |  | Thickness |  | 2nd Doig Sand |  | Thickness |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  | BLLY | SS | 1st Sand | SS | Sand | Silt Eq. | 2nd Sand | SS | Sand | Silt Eq. |
| 100/06-05-083-20W600 |  |  | NDE |  |  |  |  |  |  |  |
| 100/06-06-083-20W600 |  |  |  |  |  |  |  |  |  |  |
| 100/06-07-083-20W600 |  |  |  |  |  |  |  |  |  |  |
| 100/06-10-083-20W600 |  |  | 1538.0 | -901.0 | 7.0 |  | NDE |  |  |  |
| 100/10-12-083-20W600 | 1943.0 | -1294.4 | 1567.0 | -918.4 | 15.5 | 19.0 | ? NP |  | 0.0 |  |
| 100/08-13-083-20W600 |  |  | NDE |  |  |  |  |  |  |  |
| 100/10-14-083-20W600 | 1932.4 | -1290.5 | 1548.9 | -907.0 | 10.4 | 11.6 |  |  |  |  |
| 100/11-16-083-20W600 |  |  | ? 1504.4 |  |  |  |  |  |  |  |
| 100/11-18-083-20W600 |  |  |  |  |  |  |  |  |  |  |
| 100/11-19-083-20W600 |  |  |  |  |  |  |  |  |  |  |
| 100/06-22-083-20W600 |  |  |  |  |  |  |  |  |  |  |
| 100/11-28-083-20W600 |  |  | NDE |  |  |  |  |  |  |  |
| 100/09-33-083-20W600 | 1886.7 | -1251.5 | 1566.1 | -930.9 | 1.2 | 2.0 | ? NP |  | 0.0 |  |
| 100/06-35-083-20W600 |  |  | 1518.4 | -874.1 | FS | FS |  |  |  |  |
| 100/10-01-083-21W600 |  |  | NDE |  |  |  | NDE |  |  |  |
| 100/10-02-083-21W600 |  |  | NDE |  |  |  | NDE |  |  |  |
| 100/10-03-083-21W600 |  |  | ? NDE |  |  |  | NDE |  |  |  |
| 100/10-04-083-21W600 | 1908.0 | -1253.3 | ? NP |  | 0.0 |  | ? NP |  | 0.0 |  |
| 100/14-05-083-21W600 |  |  |  |  |  |  | NDE |  |  |  |
| 100/10-06-083-21W600 |  |  | NDE |  |  |  | NDE |  |  |  |
| 100/07-07-083-21W600 |  |  |  |  |  |  | 1580.0 | -921.3 | 5.0 | 6.5 |
| 100/07-08-083-21W600 |  |  | NDE |  |  |  | NDE |  |  |  |
| 100/06-10-083-21W600 |  |  | NDE |  |  |  | NDE |  |  |  |
| 100/10-10-083-21W600 |  |  | NDE |  |  |  | NDE |  |  |  |
| 100/10-11-083-21W600 |  |  | NDE |  |  |  | NDE |  |  |  |
| 100/14-12-083-21W600 |  |  | NDE |  |  |  | NDE |  |  |  |
| 100/11-13-083-21W600 |  |  | ?1594 | -958.5 | 0.0 |  | 1527.0 | -891.5 | 0.0 | ? 52 |
| 100/10-14-083-21W600 |  |  | NDE |  |  |  |  |  |  |  |
| 100/10-15-083-21W600 |  |  | NDE |  |  |  |  |  |  |  |
| 100/07-16-083-21W600 |  |  |  |  |  |  | 1566.0 | -902.1 | ? | NDE |
| 100/11-19-083-21W600 |  |  |  |  |  |  | 1586.0 | -923.3 | 0.0 | 2.0 |
| 100/06-21-083-21W600 |  |  | ? |  |  |  | NDE |  |  |  |
| 100/10-22-083-21W600 |  |  |  |  |  |  | ? 1467.5 | -830.8 | ? | NDE |
| 100/10-23-083-21W600 |  |  | NDE |  |  |  | NDE |  |  |  |
| 102/11-24-083-21W600 |  |  | ?NP |  | 0.0 |  | 1509.5 | -875.7 | 0.0 |  |
| 100/06-26-083-21W600 |  |  | NDE |  |  |  | 1515.0 | -881.2 | 2.0 |  |
| 100/10-29-083-21W600 |  |  | ? NDE |  |  |  | NDE |  |  |  |
| 100/07-33-083-21W600 |  |  | NDE |  |  |  | NDE |  |  |  |
| 100/04-34-083-21W600 | 1841.6 | -1212.8 | ?NP |  | 0.0 |  | 1474.6 | -845.8 | 11.0 | 16.5 |
| 100/06-36-083-21W600 |  |  | ?1542 | -918.7 | >7.0 | OFF-SC | 1510.0 | -886.7 | 9.0 |  |
| 100/06-02-083-22W600 |  |  |  |  |  |  |  |  |  |  |
| 100/07-03-083-22W600 |  |  | NDE |  |  |  | NDE |  |  |  |
| 100/06-09-083-22W600 |  |  | ? |  |  |  |  |  |  |  |
| 100/01-27-083-22W600 |  |  |  |  |  |  |  |  |  |  |
| 100/06-21-083-23W600 |  |  | NDE |  |  |  | NDE |  |  |  |
| 100/12-11-083-24W600 |  |  |  |  |  |  |  |  |  |  |
| 100/06-17-083-24W600 | 2265.0 | -1591.0 | ? NP |  | 0.0 |  | ? 1750 | -1076.0 | 13.0 | 18.0 |
| 100/10-36-083-25W600 | 2317.0 | -1601.7 | ? NP |  | 0.0 |  | 1824.0 | -1108.7 | 10.0 |  |
| 100/11-07-084-19W600 |  |  |  |  |  |  |  |  |  |  |
| 100/06-13-084-19W600 | 1887.3 | -1168.6 | ? NP |  | 0.0 |  | ? NP |  | 0.0 |  |
| 100/02-18-084-19W600 | 1981.2 | -1219.2 |  |  |  |  |  |  |  |  |
| 100/11-21-084-19W600 | 1892.8 | -1163.4 |  |  |  |  |  |  |  |  |
| 100/13-01-084-20W600 | 2051.9 | -1233.2 |  |  |  |  |  |  |  |  |
| 100/07-02-084-20W600 |  |  | ? NDE |  |  |  | NDE |  |  |  |

| WELL ID | DOIG<br>GAS | DOIG<br>OIL | CORE | COMMENTS |
|---|---|---|---|---|
| 100/06-05-083-20W600 | | | | |
| 100/06-06-083-20W600 | | | | |
| 100/06-07-083-20W600 | | | | |
| 100/06-10-083-20W600 | | | | |
| 100/10-12-083-20W600 | | | | |
| 100/08-13-083-20W600 | | | | |
| 100/10-14-083-20W600 | | | | |
| 100/11-16-083-20W600 | | | | |
| 100/11-18-083-20W600 | | | | |
| 100/11-19-083-20W600 | | | | |
| 100/06-22-083-20W600 | | | | |
| 100/11-28-083-20W600 | | | | |
| 100/09-33-083-20W600 | | | | |
| 100/06-35-083-20W600 | | | | |
| 100/10-01-083-21W600 | | | | |
| 100/10-02-083-21W600 | | | | |
| 100/10-03-083-21W600 | | | | |
| 100/10-04-083-21W600 | | | | |
| 100/14-05-083-21W600 | | | | |
| 100/10-06-083-21W600 | | | | |
| 100/07-07-083-21W600 | | | | |
| 100/07-08-083-21W600 | | | | |
| 100/06-10-083-21W600 | | | | |
| 100/10-10-083-21W600 | | | | |
| 100/10-11-083-21W600 | | | | |
| 100/14-12-083-21W600 | | | | |
| 100/11-13-083-21W600 | | | | |
| 100/10-14-083-21W600 | | | | |
| 100/10-15-083-21W600 | | | | |
| 100/07-16-083-21W600 | | | | |
| 100/11-19-083-21W600 | | | | |
| 100/06-21-083-21W600 | | | | |
| 100/10-22-083-21W600 | | | | |
| 100/10-23-083-21W600 | | | | |
| 102/11-24-083-21W600 | | | | |
| 100/06-26-083-21W600 | | | | |
| 100/10-29-083-21W600 | | | | |
| 100/07-33-083-21W600 | | | | |
| 100/04-34-083-21W600 | | | | |
| 100/06-36-083-21W600 | | | | 7m offscale gamma response at base log (2nd DOIG Sand?) |
| 100/06-02-083-22W600 | | | | |
| 100/07-03-083-22W600 | | | | |
| 100/06-09-083-22W600 | | | | |
| 100/01-27-083-22W600 | | | | no fiche available |
| 100/06-21-083-23W600 | | | | |
| 100/12-11-083-24W600 | | | | |
| 100/06-17-083-24W600 | | | | |
| 100/10-36-083-25W600 | | | | |
| 100/11-07-084-19W600 | | | | |
| 100/06-13-084-19W600 | | | | |
| 100/02-18-084-19W600 | | | | |
| 100/11-21-084-19W600 | | | | |
| 100/13-01-084-20W600 | | | | e-log |
| 100/07-02-084-20W600 | | | | |

| | WELL ID | | Top Triassic | | Halfway | | Doig | | Montney | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | KB | BLDN | SS | HLFY | SS | DOIG | SS | MNTN | SS |
| • | 100/06-13-084-20W600 | 754.7 | 1257.0 | -502.3 | 1580.7 | -826.0 | 1594.7 | -840.0 | | |
| • | 100/05-15-084-20W600 | 691.5 | 1204.0 | -512.5 | 1537.0 | -845.5 | 1553.0 | -861.5 | | |
| • | 100/07-16-084-20W600 | 750.1 | 1253.3 | -503.2 | 1588.3 | -838.2 | 1604.5 | -854.4 | 1702.9 | -952.8 |
| | 100/11-18-084-20W600 | 857.4 | 1341.1 | -483.7 | 1678.8 | -821.4 | 1709.3 | -851.9 | | |
| • | 100/11-26-084-20W600 | 793.9 | 1288.0 | -494.1 | 1604.0 | -810.1 | 1618.0 | -824.1 | | |
| | 100/06-27-084-20W600 | 845.2 | 1338.4 | -493.2 | 1655.1 | -809.9 | NDE | | | |
| • | 100/06-30-084-20W600 | 810.2 | 1303.9 | -493.7 | 1637.4 | -827.2 | 1653.8 | -843.6 | | |
| • | 100/06-34-084-20W600 | 826.9 | 1332.0 | -505.1 | 1644.0 | -817.1 | 1656.0 | -829.1 | 1752.5 | -925.6 |
| • | 100/10-03-084-21W600 | 617.8 | 1083.6 | -465.8 | 1427.7 | -809.9 | 1449.0 | -831.2 | | |
| • | 100/07-08-084-21W600 | 507.5 | 965.0 | -457.5 | 1321.0 | -813.5 | 1340.0 | -832.5 | 1449.0 | -941.5 |
| • | 100/11-09-084-21W600 | 483.7 | 949.5 | -465.8 | 1303.0 | -819.3 | 1327.0 | -843.3 | | |
| • | 100/12-12-084-21W600 | 498.8 | 983.0 | -484.2 | 1325.0 | -826.2 | 1340.0 | -841.2 | 1450.0 | -951.2 |
| • | 100/10-14-084-21W600 | 772.5 | 1255.0 | -482.5 | 1609.0 | -836.5 | 1626.0 | -853.5 | | |
| • | 100/10-22-084-21W600 | 650.4 | 1148.0 | -497.6 | 1491.0 | -840.6 | 1512.0 | -861.6 | | |
| • | 100/12-24-084-21W600 | 782.4 | 1269.0 | -486.6 | 1616.0 | -833.6 | 1630.5 | -848.1 | 1728.0 | -945.6 |
| • | 100/11-27-084-21W600 | 650.7 | 1140.0 | -489.3 | 1482.2 | -831.5 | 1502.4 | -851.7 | 1593.5 | -942.8 |
| • | 100/02-28-084-21W600 | 622.7 | 1112.5 | -489.8 | 1460.0 | -837.3 | 1482.0 | -859.3 | | |
| • | 100/10-32-084-21W600 | 755.9 | 1232.9 | -477.0 | 1588.0 | -832.1 | 1607.5 | -851.6 | | |
| • | 100/06-08-084-22W600 | 639.5 | 1124.1 | -484.6 | 1512.4 | -872.9 | 1554.4 | -914.9 | 1669.9 | -1030.4 |
| • | 100/06-10-084-22W600 | 629.1 | 1115.0 | -485.9 | 1491.5 | -862.4 | 1527.0 | -897.9 | 1641.0 | -1011.9 |
| • | 100/15-17-084-22W600 | 636.2 | 1161.0 | -524.8 | 1530.0 | -893.8 | 1563.0 | -926.8 | 1673.0 | -1036.8 |
| • | 100/07-20-084-22W600 | 637.3 | 1144.5 | -507.2 | 1515.5 | -878.2 | 1552.6 | -915.3 | 1659.9 | -1022.6 |
| • | 100/07-22-084-22W600 | 637.0 | 1126.2 | -489.2 | 1491.1 | -854.1 | 1531.9 | -894.9 | 1630.6 | -993.6 |
| • | 100/07-26-084-22W600 | 698.0 | 1187.0 | -489.0 | 1555.0 | -857.0 | 1575.0 | -877.0 | 1678.5 | -980.5 |
| • | 102/07-26-084-22W600 | 698.0 | 1187.3 | -489.3 | 1554.0 | -856.0 | 1572.5 | -874.5 | 1676.0 | -978.0 |
| • | 100/06-29-084-22W600 | 636.5 | 1154.0 | -517.5 | 1527.0 | -890.5 | 1562.0 | -925.5 | 1669.0 | -1032.5 |
| • | 100/01-12-084-23W600 | 646.8 | 1133.9 | -487.1 | 1524.0 | -877.2 | 1569.7 | -922.9 | 1688.6 | -1041.8 |
| • | 100/04-24-084-23W600 | 646.8 | 1172.0 | -525.2 | 1549.5 | -902.7 | 1594.0 | -947.2 | 1705.5 | -1058.7 |
| • | 100/16-25-084-23W600 | 648.6 | 1176.5 | -527.9 | 1543.4 | -894.8 | NDE | | | |
| • | 100/06-29-084-23W600 | 662.0 | 1228.0 | -566.0 | 1612.0 | -950.0 | 1647.0 | -985.0 | | |
| • | 100/10-29-084-23W600 | 657.8 | 1209.4 | -551.6 | 1589.1 | -931.3 | 1628.5 | -970.7 | | |
| • | 100/05-05-084-24W600 | 766.6 | 1385.0 | -618.4 | ? 1795.2 | -1028.6 | ? 1833.0 | -1066.4 | 2008.5 | -1241.9 |
| • | 100/07-19-084-24W600 | 732.7 | 1310.3 | -577.6 | 1698.3 | -965.6 | 1754.3 | -1021.6 | 1890.6 | -1157.9 |
| • | 102/04-31-084-24W600 | 724.5 | 1272.0 | -547.5 | 1664.5 | -940.0 | ? 1707.0 | -982.5 | | |
| • | 100/10-22-084-25W600 | 719.9 | 1415.0 | -695.1 | 1819.0 | -1099.1 | 1847.0 | -1127.1 | 2007.0 | -1287.1 |
| • | 100/11-03-085-20W600 | 838.9 | 1338.0 | -499.1 | 1650.0 | -811.1 | 1776.0 | -937.1 | NDE | |
| • | 100/10-06-085-20W600 | 765.5 | 1254.5 | -489.0 | 1580.0 | -814.5 | 1600.0 | -834.5 | 1686.0 | -920.5 |
| | 100/06-07-085-20W600 | 839.4 | 1327.7 | -488.3 | 1650.5 | -811.1 | 1674.3 | -834.9 | 1757.2 | -917.8 |
| • | 100/11-10-085-20W600 | 796.1 | 1289.9 | -493.8 | 1597.7 | -801.6 | 1617.2 | -821.1 | 1705.6 | -909.5 |
| • | 100/06-13-085-20W600 | 755.0 | 1249.7 | -494.7 | 1545.0 | -790.0 | 1562.3 | -807.3 | 1651.9 | -896.9 |
| • | 100/14-16-085-20W600 | 776.6 | 1272.0 | -495.4 | 1580.0 | -803.4 | 1600.0 | -823.4 | 1690.0 | -913.4 |
| • | 100/06-18-085-20W600 | 859.0 | 1354.0 | -495.0 | 1667.0 | -808.0 | 1702.0 | -843.0 | 1785.0 | -926.0 |
| • | 100/06-21-085-20W600 | 808.3 | 1309.0 | -500.7 | 1615.0 | -806.7 | 1634.0 | -825.7 | | |
| • | 100/08-21-085-20W600 | 756.1 | 1246.5 | -490.4 | 1552.0 | -795.9 | 1572.0 | -815.9 | 1662.0 | -905.9 |
| • | 100/16-21-085-20W600 | 744.5 | 1242.0 | -497.5 | NDE | | | | | |
| • | 102/16-21-085-20W600 | 742.5 | 1238.5 | -496.0 | 1538.0 | -795.5 | 1557.0 | -814.5 | 1647.0 | -904.5 |
| • | 100/12-22-085-20W600 | 734.6 | 1230.0 | -495.4 | 1528.0 | -793.4 | 1547.0 | -812.4 | 1637.0 | -902.4 |
| • | 100/14-22-085-20W600 | 752.3 | 1248.0 | -495.7 | 1544.0 | -791.7 | 1561.0 | -808.7 | 1651.0 | -898.7 |
| ? | 100/15-22-085-20W600 | 706.8 | 1206.0 | -499.2 | 1501.0 | -794.2 | | | | |
| ? | 100/16-22-085-20W600 | 703.6 | 1203.0 | -499.4 | 1498.0 | -794.4 | 1516.0 | -812.4 | 1605.5 | -901.9 |
| • | 100/08-23-085-20W600 | 723.4 | 1215.0 | -491.6 | 1509.7 | -786.3 | 1540.0 | -816.6 | 1599.0 | -875.6 |
| • | 100/14-23-085-20W600 | 735.0 | 1229.0 | -494.0 | 1521.0 | -786.0 | 1536.0 | -801.0 | 1630.0 | -895.0 |
| • | 100/16-23-085-20W600 | 739.7 | 1229.0 | -489.3 | 1522.0 | -782.3 | 1540.0 | -800.3 | 1630.0 | -890.3 |
| • | 100/08-24-085-20W600 | 800.5 | 1296.5 | -496.0 | 1590.0 | -789.5 | 1606.0 | -805.5 | 1697.0 | -896.5 |

| WELL ID | Base Triassic | | 1st Doig Sand | | Thickness | | 2nd Doig Sand | | Thickness | |
|---|---|---|---|---|---|---|---|---|---|---|
| | BLLY | SS | 1st Sand | SS | Sand | Silt Eq. | 2nd Sand | SS | Sand | Silt Eq. |
| 100/06-13-084-20W600 | | | ? NDE | | | | NDE | | | |
| 100/05-15-084-20W600 | | | | | | | | | | |
| 100/07-16-084-20W600 | 2009.2 | -1259.1 | 1688.8 | -938.7 | 0.0 | 4.0 | ? NP | | 0.0 | |
| 100/11-18-084-20W600 | | | | | | | | | | |
| 100/11-26-084-20W600 | | | NDE | | | | | | | |
| 100/06-27-084-20W600 | | | | | | | | | | |
| 100/06-30-084-20W600 | | | NDE | | | | | | | |
| 100/06-34-084-20W600 | 2045.0 | -1218.1 | 1726.0 | -899.1 | 0.0 | 5.0 | ? NP | | 0.0 | |
| 100/10-03-084-21W600 | | | NDE | | | | NDE | | | |
| 100/07-08-084-21W600 | 1745.0 | -1237.5 | ? 1428 | -920.5 | 0.0 | 3.0 | ? NP | | 0.0 | |
| 100/11-09-084-21W600 | | | | | | | 1358.0 | -874.3 | 10.0 | offscale |
| 100/12-12-084-21W600 | 1746.0 | -1247.2 | ? 1432 | -933.2 | 0.0 | 4.0 | 1358.5 | -859.7 | 11.0 | 13.5 |
| 100/10-14-084-21W600 | | | ? | | | | | | | |
| 100/10-22-084-21W600 | | | NDE | | | | NDE | | | |
| 100/12-24-084-21W600 | | | ? 1707 | -924.6 | 3.0 | | 1648.0 | -865.6 | ?5.0 | 27.0 |
| 100/11-27-084-21W600 | 1890.7 | -1240.0 | 1566.6 | -915.9 | ? 4.3 | 4.3 | 1520.9 | -870.2 | 3.0 | 3.5 |
| 100/02-28-084-21W600 | | | 1547.0 | -924.3 | 3.0 | 5.0 | | | | |
| 100/10-32-084-21W600 | | | 1670.8 | -914.9 | 3.0 | 4.0 | | | | |
| 100/06-08-084-22W600 | 1973.6 | -1334.1 | | | | | 1642.8 | -1003.3 | 0.0 | 2.4 |
| 100/06-10-084-22W600 | 1950.5 | -1321.4 | | | | | 1619.5 | -990.4 | 3.5 | 4.0 |
| 100/15-17-084-22W600 | 1980.0 | -1343.8 | NP | | 0.0 | 0.0 | ? NP | | 0.0 | |
| 100/07-20-084-22W600 | 1957.7 | -1320.4 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/07-22-084-22W600 | 1931.5 | -1294.5 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/07-26-084-22W600 | 1975.0 | -1277.0 | ? NP | | 0.0 | | 1647.5 | -949.5 | 1.5 | 2.0 |
| 102/07-26-084-22W600 | 1974.0 | -1276.0 | ? NP | | 0.0 | | 1645.0 | -947.0 | 2.0 | 3.0 |
| 100/06-29-084-22W600 | 1975.0 | -1338.5 | NP | | 0.0 | 0.0 | NP | | 0.0 | 0.0 |
| 100/01-12-084-23W600 | 1996.4 | -1349.6 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/04-24-084-23W600 | 2026.5 | -1379.7 | ? NP | | 0.0 | | ? 1664 | -1017.2 | 0.0 | 2.0 |
| 100/16-25-084-23W600 | | | | | | | | | | |
| 100/06-29-084-23W600 | | | | | | | 1678.0 | -1016.0 | spike at end log | |
| 100/10-29-084-23W600 | | | NDE | | | | NDE | | | |
| 100/05-05-084-24W600 | 2343.9 | -1577.3 | ? 1975.6 | -1209.0 | | 3.7 | 1906.7 | -1140.1 | | 4.0 |
| 100/07-19-084-24W600 | 2231.7 | -1499.0 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 102/04-31-084-24W600 | | | NDE | | | | NDE | | | |
| 100/10-22-084-25W600 | 2335.3 | -1615.4 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/11-03-085-20W600 | | | ? 1686 | -847.1 | 4.0 | 4.0 | | | | |
| 100/10-06-085-20W600 | 1976.5 | -1211.0 | ? 1652.5 | -887.0 | trace | 5.0 | ? NP | | 0.0 | |
| 100/06-07-085-20W600 | 2048.0 | -1208.6 | | | | | | | | |
| 100/11-10-085-20W600 | 1988.5 | -1192.4 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/06-13-085-20W600 | 1933.0 | -1178.0 | 1611.7 | -856.7 | 0.0 | 6.1 | ? NP | | 0.0 | |
| 100/14-16-085-20W600 | 1973.0 | -1196.4 | 1649.0 | -872.4 | 1.5 | 7.0 | ? NP | | 0.0 | |
| 100/06-18-085-20W600 | 2077.0 | -1218.0 | 1745.0 | -886.0 | 0.0 | 7.0 | ? NP | | 0.0 | |
| 100/06-21-085-20W600 | | | NDE | | | | | | | |
| 100/08-21-085-20W600 | 1942.5 | -1186.4 | 1619.5 | -863.4 | 1.0 | 6.5 | ? NP | | 0.0 | |
| 100/16-21-085-20W600 | | | | | | | | | | |
| 102/16-21-085-20W600 | 1926.0 | -1183.5 | 1603.0 | -860.5 | 0.0 | 8.0 | ? NP | | 0.0 | |
| 100/12-22-085-20W600 | 1915.0 | -1180.4 | 1594.0 | -859.4 | 1.0 | 6.0 | ? NP | | 0.0 | |
| 100/14-22-085-20W600 | 1930.5 | -1178.2 | 1608.0 | -855.7 | 7.0 | 7.0 | ? NP | | 0.0 | |
| 100/15-22-085-20W600 | 1975.0 | -1268.2 | | | | | | | | |
| 100/16-22-085-20W600 | 1885.5 | -1181.9 | 1559.0 | -855.4 | 0.0 | 10.0 | ? NP | | 0.0 | |
| 100/08-23-085-20W600 | 1895.7 | -1172.3 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/14-23-085-20W600 | 1906.0 | -1171.0 | 1584.0 | -849.0 | ? 7 | 7.0 | ? NP | | 0.0 | |
| 100/16-23-085-20W600 | 1907.0 | -1167.3 | 1582.5 | -842.8 | ? 8.5 | 8.5 | ? NP | | 0.0 | |
| 100/08-24-085-20W600 | 1974.5 | -1174.0 | 1650.0 | -849.5 | ? 8 | 8.0 | ? NP | | 0.0 | |

| WELL ID | DOIG | DOIG | CORE | COMMENTS |
|---|---|---|---|---|
| | GAS | OIL | | |
| 100/06-13-084-20W600 | | | | |
| 100/05-15-084-20W600 | | | | 1554 - FS; 1582.5 - FS (Subsea: -862.5m and -891.0m) |
| 100/07-16-084-20W600 | | | | 1605.6 - FS; 1610.5 - FS; 1618.7 - FS (Subsea: -855.5m, -860.4m, -868.4m) |
| 100/11-18-084-20W600 | | | | e-log |
| 100/11-26-084-20W600 | | | | |
| 100/06-27-084-20W600 | | | | |
| 100/06-30-084-20W600 | | | | |
| 100/06-34-084-20W600 | | | | |
| 100/10-03-084-21W600 | | | | |
| 100/07-08-084-21W600 | | | | |
| 100/11-09-084-21W600 | | | | |
| 100/12-12-084-21W600 | | | | |
| 100/10-14-084-21W600 | | | | |
| 100/10-22-084-21W600 | | | | |
| 100/12-24-084-21W600 | | | D | 1675 : Erosional Break? |
| 100/11-27-084-21W600 | | | | |
| 100/02-28-084-21W600 | | X | | |
| 100/10-32-084-21W600 | | | | |
| 100/06-08-084-22W600 | | | | |
| 100/06-10-084-22W600 | | | | |
| 100/15-17-084-22W600 | | | | |
| 100/07-20-084-22W600 | | | | 1.0m silt on top of 1st Phosphate |
| 100/07-22-084-22W600 | | | | 1.0m silt on top of 1st Phosphate |
| 100/07-26-084-22W600 | | | | |
| 102/07-26-084-22W600 | | | | |
| 100/06-29-084-22W600 | | | | |
| 100/01-12-084-23W600 | | | | only e-log below 2700 feet (823m) |
| 100/04-24-084-23W600 | | | | |
| 100/16-25-084-23W600 | | | | |
| 100/06-29-084-23W600 | | | | |
| 100/10-29-084-23W600 | | | | |
| 100/05-05-084-24W600 | | | | |
| 100/07-19-084-24W600 | | | | |
| 102/04-31-084-24W600 | | | | |
| 100/10-22-084-25W600 | | | | |
| 100/11-03-085-20W600 | X | | | |
| 100/10-06-085-20W600 | | | | |
| 100/06-07-085-20W600 | | | | e-log |
| 100/11-10-085-20W600 | | | | crude quality gamma log |
| 100/06-13-085-20W600 | | | | 1579.3 - FS (Subsea: -824.3) |
| 100/14-16-085-20W600 | | | | 1615.5 - FS (Subsea: -838.9) |
| 100/06-18-085-20W600 | | | | |
| 100/06-21-085-20W600 | | | | |
| 100/08-21-085-20W600 | | | | |
| 100/16-21-085-20W600 | | | | |
| 102/16-21-085-20W600 | | | | |
| 100/12-22-085-20W600 | | | | |
| 100/14-22-085-20W600 | | | | |
| 100/15-22-085-20W600 | | | | |
| 100/16-22-085-20W600 | | | | |
| 100/08-23-085-20W600 | | | | |
| 100/14-23-085-20W600 | | | | 1st Doig Sand Eq. - 7m sandy silt |
| 100/16-23-085-20W600 | | | | 1st Doig Sand Eq. - 8.5m sand ? |
| 100/08-24-085-20W600 | | | | 1st Doig Sand Eq. - 8m sandy silt |

| | WELL ID | | Top Triassic | | Halfway | | Doig | | Montney | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | KB | BLDN | SS | HLFY | SS | DOIG | SS | MNTN | SS |
| • | 100/14-24-085-20W600 | 750.1 | 1237.3 | -487.2 | 1531.0 | -780.9 | 1551.0 | -800.9 | 1639.0 | -888.9 |
| • | 100/16-24-085-20W600 | 785.7 | 1271.0 | -485.3 | 1563.0 | -777.3 | 1581.0 | -795.3 | 1670.0 | -884.3 |
| | 100/06-25-085-20W600 | 775.5 | 1261.0 | -485.5 | 1551.0 | -775.5 | 1579.0 | -803.5 | 1657.5 | -882.0 |
| | 100/08-25-085-20W600 | 759.6 | 1250.0 | -490.4 | 1539.5 | -779.9 | 1566.0 | -806.4 | 1644.5 | -884.9 |
| | 100/14-25-085-20W600 | 816.8 | 1306.5 | -489.7 | 1595.5 | -778.7 | 1622.0 | -805.2 | 1702.5 | -885.7 |
| | 100/16-25-085-20W600 | 781.3 | 1273.5 | -492.2 | 1561.0 | -779.7 | 1591.0 | -809.7 | 1666.0 | -884.7 |
| | 100/04-26-085-20W600 | 703.0 | 1198.0 | -495.0 | 1491.0 | -788.0 | 1519.0 | -816.0 | 1604.0 | -901.0 |
| | 100/05-26-085-20W600 | 717.6 | 1210.5 | -492.9 | 1505.0 | -787.4 | 1548.0 | -830.4 | 1615.0 | -897.4 |
| | 100/06-26-085-20W600 | 737.0 | 1229.0 | -492.0 | 1521.5 | -784.5 | 1552.0 | -815.0 | 1630.0 | -893.0 |
| | 100/08-26-085-20W600 | 766.3 | 1256.0 | -489.7 | 1548.5 | -782.2 | 1576.5 | -810.2 | 1657.0 | -890.7 |
| | 100/10-26-085-20W600 | 748.3 | 1235.0 | -486.7 | 1527.0 | -778.7 | 1555.0 | -806.7 | 1635.0 | -886.7 |
| | 100/12-26-085-20W600 | 710.4 | 1203.0 | -492.6 | 1496.0 | -785.6 | 1525.0 | -814.6 | 1605.0 | -894.6 |
| | 100/13-26-085-20W600 | 706.1 | 1199.5 | -493.4 | 1500.0 | -793.9 | 1535.0 | -828.9 | 1610.0 | -903.9 |
| | 100/14-26-085-20W600 | 757.2 | 1244.5 | -487.3 | 1537.0 | -779.8 | 1568.0 | -810.8 | 1645.0 | -887.8 |
| | 100/16-26-085-20W600 | 763.4 | 1251.5 | -488.1 | 1542.0 | -778.6 | 1569.0 | -805.6 | 1648.5 | -885.1 |
| | 100/02-27-085-20W600 | 765.0 | 1282.0 | -517.0 | 1599.0 | -834.0 | 1630.0 | -865.0 | 1715.0 | -950.0 |
| • | 100/04-27-085-20W600 | 738.6 | 1230.0 | -491.4 | 1530.0 | -791.4 | 1549.0 | -810.4 | 1639.0 | -900.4 |
| • | 100/06-27-085-20W600 | 769.0 | 1262.0 | -493.0 | 1557.0 | -788.0 | 1573.0 | -804.0 | 1667.0 | -898.0 |
| | 100/08-27-085-20W600 | 697.0 | 1191.5 | -494.5 | 1485.1 | -788.1 | 1513.0 | -816.0 | 1596.0 | -899.0 |
| | 100/09-27-085-20W600 | 700.1 | 1192.0 | -491.9 | 1488.0 | -787.9 | 1515.0 | -814.9 | 1598.0 | -897.9 |
| | 100/10-27-085-20W600 | 728.2 | 1220.0 | -491.8 | 1517.0 | -788.8 | 1550.0 | -821.8 | 1624.0 | -895.8 |
| • | 100/11-27-085-20W600 | 772.9 | 1265.0 | -492.1 | 1561.0 | -788.1 | 1576.0 | -803.1 | 1671.0 | -898.1 |
| | 100/14-27-085-20W600 | 771.1 | 1260.0 | -488.9 | 1558.0 | -786.9 | 1597.0 | -825.9 | 1667.0 | -895.9 |
| | 100/16-27-085-20W600 | 696.2 | 1185.0 | -488.8 | 1482.0 | -785.8 | 1510.0 | -813.8 | 1590.0 | -893.8 |
| • | 100/06-28-085-20W600 | 753.8 | 1250.6 | -496.8 | 1556.2 | -802.4 | 1573.9 | -820.1 | 1663.9 | -910.1 |
| • | 100/08-28-085-20W600 | 756.5 | 1250.0 | -493.5 | 1549.0 | -792.5 | 1568.0 | -811.5 | 1656.5 | -900.0 |
| • | 100/16-28-085-20W600 | 784.5 | 1276.0 | -491.5 | 1573.0 | -788.5 | 1589.0 | -804.5 | 1683.0 | -898.5 |
| • | 100/10-30-085-20W600 | 837.3 | 1334.7 | -497.4 | 1645.2 | -807.9 | 1677.0 | -839.7 | 1755.6 | -918.3 |
| • | 100/16-32-085-20W600 | 820.2 | 1314.5 | -494.3 | 1612.7 | -792.5 | 1640.0 | -819.8 | 1725.5 | -905.3 |
| | 100/06-33-085-20W600 | 826.0 | 1320.4 | -494.4 | 1617.3 | -791.3 | 1643.8 | -817.8 | 1732.8 | -906.8 |
| • | 100/08-33-085-20W600 | 803.5 | 1292.0 | -488.5 | 1590.0 | -786.5 | 1614.0 | -810.5 | 1698.0 | -894.5 |
| • | 100/14-33-085-20W600 | 798.3 | 1291.0 | -492.7 | 1587.0 | -788.7 | 1614.0 | -815.7 | 1697.0 | -898.7 |
| | 100/16-33-085-20W600 | 769.1 | 1256.0 | -486.9 | 1552.5 | -783.4 | 1578.0 | -808.9 | 1660.0 | -890.9 |
| • | 100/02-34-085-20W600 | 712.9 | 1206.0 | -493.1 | 1502.0 | -789.1 | 1529.0 | -816.1 | 1610.0 | -897.1 |
| | 100/06-34-085-20W600 | 765.7 | 1255.2 | -489.5 | 1552.3 | -786.6 | 1587.4 | -821.7 | 1661.8 | -896.1 |
| | 100/08-34-085-20W600 | 702.0 | 1190.5 | -488.5 | 1483.5 | -781.5 | 1510.0 | -808.0 | 1590.0 | -888.0 |
| • | 100/10-34-085-20W600 | 709.6 | 1199.0 | -489.4 | 1495.0 | -785.4 | 1521.7 | -812.1 | 1603.5 | -893.9 |
| | 100/14-34-085-20W600 | 728.1 | 1217.0 | -488.9 | 1512.5 | -784.4 | 1539.5 | -811.4 | 1623.0 | -894.9 |
| | 100/16-34-085-20W600 | 699.7 | 1187.0 | -487.3 | 1479.6 | -779.9 | 1512.0 | -812.3 | 1590.0 | -890.3 |
| | 100/02-35-085-20W600 | 770.8 | 1259.0 | -488.2 | 1549.5 | -778.7 | 1577.0 | -806.2 | 1657.0 | -886.2 |
| | 100/04-35-085-20W600 | 711.6 | 1201.0 | -489.4 | 1492.0 | -780.4 | 1520.0 | -808.4 | 1600.0 | -888.4 |
| | 100/06-35-085-20W600 | 743.1 | 1233.0 | -489.9 | 1522.0 | -778.9 | 1549.0 | -805.9 | 1629.0 | -885.9 |
| • | 100/07-35-085-20W600 | 748.6 | 1239.0 | -490.4 | 1530.0 | -781.4 | 1557.0 | -808.4 | 1638.0 | -889.4 |
| | 100/08-35-085-20W600 | 774.8 | 1266.1 | -491.3 | 1558.7 | -783.9 | 1588.6 | -813.8 | 1664.5 | -889.7 |
| | 102/08-35-085-20W600 | 768.1 | 1261.0 | -492.9 | 1552.5 | -784.4 | 1579.0 | -810.9 | 1660.0 | -891.9 |
| • | 100/10-35-085-20W600 | 755.9 | 1247.0 | -491.1 | 1539.0 | -783.1 | 1565.0 | -809.1 | 1647.0 | -891.1 |
| • | 100/12-35-085-20W600 | 765.2 | 1255.0 | -489.8 | 1546.5 | -781.3 | 1573.0 | -807.8 | 1655.0 | -889.8 |
| | 100/14-35-085-20W600 | 788.1 | 1280.0 | -491.9 | 1572.0 | -783.9 | 1598.0 | -809.9 | 1681.0 | -892.9 |
| | 100/15-35-085-20W600 | 773.1 | 1266.3 | -493.2 | 1557.0 | -783.9 | 1583.0 | -809.9 | 1665.5 | -892.4 |
| | 100/16-35-085-20W600 | 766.3 | 1261.0 | -494.7 | 1550.0 | -783.7 | 1575.0 | -808.7 | 1656.5 | -890.2 |
| | 100/04-36-085-20W600 | 797.8 | 1270.0 | -472.2 | 1561.0 | -763.2 | 1587.0 | -789.2 | 1668.0 | -870.2 |
| | 100/06-36-085-20W600 | 805.6 | 1299.1 | -493.5 | 1585.6 | -780.0 | 1612.4 | -806.8 | 1690.7 | -885.1 |
| | 100/08-36-085-20W600 | 822.7 | 1315.0 | -492.3 | 1602.0 | -779.3 | 1627.0 | -804.3 | 1708.0 | -885.3 |
| • | 100/12-36-085-20W600 | 798.2 | 1294.5 | -496.3 | 1583.0 | -784.8 | 1608.0 | -809.8 | 1689.0 | -890.8 |

| WELL ID | Base Triassic | | 1st Doig Sand | | Thickness | | 2nd Doig Sand | | Thickness | |
|---|---|---|---|---|---|---|---|---|---|---|
| | BLLY | SS | 1st Sand | SS | Sand | Silt Eq. | 2nd Sand | SS | Sand | Silt Eq. |
| 100/14-24-085-20W600 | 1917.0 | -1166.9 | 1591.0 | -840.9 | ? 7 | 9.0 | ? NP | | 0.0 | |
| 100/16-24-085-20W600 | 1944.0 | -1158.3 | 1623.0 | -837.3 | 0.0 | 8.0 | ? NP | | 0.0 | |
| 100/06-25-085-20W600 | 1935.0 | -1159.5 | | | | | | | | |
| 100/08-25-085-20W600 | 1923.5 | -1163.9 | | | | | | | | |
| 100/14-25-085-20W600 | 1978.5 | -1161.7 | | | | | | | | |
| 100/16-25-085-20W600 | 1938.5 | -1157.2 | | | | | | | | |
| 100/04-26-085-20W600 | 1881.0 | -1178.0 | | | | | | | | |
| 100/05-26-085-20W600 | 1890.0 | -1172.4 | | | | | | | | |
| 100/06-26-085-20W600 | 1904.0 | -1167.0 | | | | | | | | |
| 100/08-26-085-20W600 | 1933.5 | -1167.2 | | | | | | | | |
| 100/10-26-085-20W600 | 1910.0 | -1161.7 | | | | | | | | |
| 100/12-26-085-20W600 | 1881.0 | -1170.6 | | | | | | | | |
| 100/13-26-085-20W600 | 1890.0 | -1183.9 | | | | | | | | |
| 100/14-26-085-20W600 | 1919.0 | -1161.8 | | | | | | | | |
| 100/16-26-085-20W600 | 1923.0 | -1159.6 | | | | | | | | |
| 100/02-27-085-20W600 | 2015.0 | -1250.0 | | | | | | | | |
| 100/04-27-085-20W600 | 1918.5 | -1179.9 | 1594.0 | -855.4 | 2.0 | 8.0 | ? NP | | 0.0 | |
| 100/06-27-085-20W600 | 1944.0 | -1175.0 | 1620.0 | -851.0 | 1.5 | 7.0 | ? NP | | 0.0 | |
| 100/08-27-085-20W600 | 1872.5 | -1175.5 | | | | | | | | |
| 100/09-27-085-20W600 | 1872.0 | -1171.9 | | | | | | | | |
| 100/10-27-085-20W600 | 1901.0 | -1172.8 | | | | | | | | |
| 100/11-27-085-20W600 | 1949.0 | -1176.1 | 1625.0 | -852.1 | 1.5 | 7.0 | ? NP | | 0.0 | |
| 100/14-27-085-20W600 | 1940.0 | -1168.9 | | | | | | | | |
| 100/16-27-085-20W600 | 1867.5 | -1171.3 | | | | | | | | |
| 100/06-28-085-20W600 | 1940.1 | -1186.3 | 1618.4 | -864.6 | sand ? | 9.8 | ? NP | | 0.0 | |
| 100/08-28-085-20W600 | 1932.5 | -1176.0 | 1612.0 | -855.5 | 1.0 | 8.0 | ? NP | | 0.0 | |
| 100/16-28-085-20W600 | 1957.5 | -1173.0 | 1634.0 | -849.5 | 1.5 | 16.0 | ? NP | | 0.0 | |
| 100/10-30-085-20W600 | 2036.1 | -1198.8 | ? 1711 | -873.0 | sand ? | 6.7 | ? NP | | 0.0 | |
| 100/16-32-085-20W600 | | | 1672.0 | -851.8 | 2.5 | 14.0 | ? NP | | 0.0 | |
| 100/06-33-085-20W600 | 2006.2 | -1180.2 | | | | | | | | |
| 100/08-33-085-20W600 | 1972.0 | -1168.5 | 1648.0 | -844.5 | 0.0 | 12.0 | ? NP | | 0.0 | |
| 100/14-33-085-20W600 | 1970.3 | -1172.0 | 1643.0 | -844.7 | 0.0 | 12.0 | ? NP | | 0.0 | |
| 100/16-33-085-20W600 | 1933.0 | -1163.9 | | | | | | | | |
| 100/02-34-085-20W600 | 1885.0 | -1172.1 | 1559.0 | -846.1 | 1.0 | 10.0 | ? NP | | 0.0 | |
| 100/06-34-085-20W600 | 1937.0 | -1171.3 | | | | | | | | |
| 100/08-34-085-20W600 | 1866.5 | -1164.5 | | | | | | | | |
| 100/10-34-085-20W600 | 1878.5 | -1168.9 | 1549.0 | -839.4 | 2.0 | 11.5 | ? NP | | 0.0 | |
| 100/14-34-085-20W600 | 1897.0 | -1168.9 | | | | | | | | |
| 100/16-34-085-20W600 | 1861.0 | -1161.3 | | | | | | | | |
| 100/02-35-085-20W600 | 1931.0 | -1160.2 | | | | | | | | |
| 100/04-35-085-20W600 | 1873.0 | -1161.4 | | | | | | | | |
| 100/06-35-085-20W600 | 1902.0 | -1158.9 | | | | | | | | |
| 100/07-35-085-20W600 | 1912.5 | -1163.9 | 1579.0 | -830.4 | 1.0 | 12.0 | ? NP | | 0.0 | |
| 100/08-35-085-20W600 | 1939.7 | -1164.9 | | | | | | | | |
| 102/08-35-085-20W600 | 1934.0 | -1165.9 | | | | | | | | |
| 100/10-35-085-20W600 | 1920.5 | -1164.6 | 1591.0 | -835.1 | 0.0 | 12.0 | ? NP | | 0.0 | |
| 100/12-35-085-20W600 | 1925.0 | -1159.8 | 1600.0 | -834.8 | 2.0 | 12.0 | ? NP | | 0.0 | |
| 100/14-35-085-20W600 | 1952.0 | -1163.9 | | | | | | | | |
| 100/15-35-085-20W600 | 1937.0 | -1163.9 | | | | | | | | |
| 100/16-35-085-20W600 | 1927.5 | -1161.2 | | | | | | | | |
| 100/04-36-085-20W600 | 1941.0 | -1143.2 | | | | | | | | |
| 100/06-36-085-20W600 | 1950.7 | -1145.1 | | | | | | | | |
| 100/08-36-085-20W600 | 1980.0 | -1157.3 | | | | | | | | |
| 100/12-36-085-20W600 | 1960.0 | -1161.8 | 1636.0 | -837.8 | ? 9.5 | 9.5 | ? NP | | 0.0 | |

| WELL ID | DOIG<br>GAS | DOIG<br>OIL | CORE | COMMENTS |
|---|---|---|---|---|
| 100/14-24-085-20W600 | | | | 1st Doig Sand Eq. - 7m silty sand |
| 100/16-24-085-20W600 | | | | |
| 100/06-25-085-20W600 | | | | |
| 100/08-25-085-20W600 | | | | |
| 100/14-25-085-20W600 | | | | |
| 100/16-25-085-20W600 | | | | |
| 100/04-26-085-20W600 | | | | |
| 100/05-26-085-20W600 | | | | |
| 100/06-26-085-20W600 | | | | |
| 100/08-26-085-20W600 | | | | |
| 100/10-26-085-20W600 | | | | |
| 100/12-26-085-20W600 | | | | |
| 100/13-26-085-20W600 | | | | |
| 100/14-26-085-20W600 | | | | |
| 100/16-26-085-20W600 | | | | |
| 100/02-27-085-20W600 | | | | |
| 100/04-27-085-20W600 | | | | |
| 100/06-27-085-20W600 | | | | |
| 100/08-27-085-20W600 | | | | |
| 100/09-27-085-20W600 | | | | |
| 100/10-27-085-20W600 | | | | |
| 100/11-27-085-20W600 | | | | |
| 100/14-27-085-20W600 | | | | |
| 100/16-27-085-20W600 | | | | |
| 100/06-28-085-20W600 | | | | |
| 100/08-28-085-20W600 | | | | |
| 100/16-28-085-20W600 | | | | |
| 100/10-30-085-20W600 | | | | |
| 100/16-32-085-20W600 | | | | TSE @ top Upper Sand ? |
| 100/06-33-085-20W600 | | | | |
| 100/08-33-085-20W600 | | | | |
| 100/14-33-085-20W600 | | | | |
| 100/16-33-085-20W600 | | | | |
| 100/02-34-085-20W600 | | | | |
| 100/06-34-085-20W600 | | | | |
| 100/08-34-085-20W600 | | | | |
| 100/10-34-085-20W600 | | | | TSE @ top Upper Sand ? |
| 100/14-34-085-20W600 | | | | |
| 100/16-34-085-20W600 | | | | |
| 100/02-35-085-20W600 | | | | |
| 100/04-35-085-20W600 | | | | |
| 100/06-35-085-20W600 | | | | |
| 100/07-35-085-20W600 | | | | TSE @ top Upper Sand |
| 100/08-35-085-20W600 | | | | |
| 102/08-35-085-20W600 | | | | |
| 100/10-35-085-20W600 | | | | TSE @ top Upper Sand |
| 100/12-35-085-20W600 | | | | TSE @ top Upper Sand |
| 100/14-35-085-20W600 | | | | |
| 100/15-35-085-20W600 | | | | |
| 100/16-35-085-20W600 | | | | |
| 100/04-36-085-20W600 | | | | |
| 100/06-36-085-20W600 | | | | |
| 100/08-36-085-20W600 | | | | |
| 100/12-36-085-20W600 | | | | TSE @ top Upper Sand |

| | WELL ID | | Top Triassic | | Halfway | | Doig | | Montney | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | KB | BLDN | SS | HLFY | SS | DOIG | SS | MNTN | SS |
| | 100/14-36-085-20W600 | 806.4 | 1301.0 | -494.6 | 1590.0 | -783.6 | 1614.0 | -807.6 | 1695.5 | -889.1 |
| • | 100/06-01-085-21W600 | 828.8 | 1328.0 | -499.2 | 1668.0 | -839.2 | 1688.0 | -859.2 | | |
| • | 100/06-03-085-21W600 | 683.4 | 1171.7 | -488.3 | 1517.8 | -834.4 | 1535.5 | -852.1 | | |
| • | 100/06-05-085-21W600 | 825.7 | 1308.5 | -482.8 | 1656.8 | -831.1 | ? NDE | | | |
| • | 100/06-08-085-21W600 | 813.5 | 1301.5 | -488.0 | 1658.6 | -845.1 | 1677.5 | -864.0 | | |
| | 100/11-10-085-21W600 | 698.0 | 1184.5 | -486.5 | 1510.0 | -812.0 | | | | |
| | 100/14-11-085-21W600 | 813.8 | 1314.0 | -500.2 | 1637.7 | -823.9 | | | | |
| • | 100/06-13-085-21W600 | 850.1 | 1348.0 | -497.9 | 1674.0 | -823.9 | 1699.0 | -848.9 | 1783.0 | -932.9 |
| SP | 100/06-14-085-21W600 | 726.9 | 1231.7 | -504.8 | 1560.5 | -833.6 | 1582.4 | -855.5 | 1668.5 | -941.6 |
| • | 100/11-15-085-21W600 | 671.8 | 1158.8 | -487.0 | 1534.9 | -863.1 | 1556.8 | -885.0 | | |
| • | 100/10-16-085-21W600 | 659.0 | 1164.5 | -505.5 | 1557.0 | -898.0 | 1583.0 | -924.0 | ? 1651 | -992.0 |
| • | 100/10-18-085-21W600 | 848.0 | 1333.8 | -485.8 | 1688.5 | -840.5 | 1709.8 | -861.8 | | |
| • | 100/07-20-085-21W600 | 747.1 | 1242.0 | -494.9 | 1591.0 | -843.9 | 1612.0 | -864.9 | ? 1701 | -953.9 |
| • | 100/10-22-085-21W600 | 771.8 | 1275.0 | -503.2 | 1599.8 | -828.0 | 1620.8 | -849.0 | | |
| • | 100/06-23-085-21W600 | 792.8 | 1300.9 | -508.1 | 1594.3 | -801.5 | 1644.6 | -851.8 | | |
| | 100/05-27-085-21W600 | 812.0 | 1315.5 | -503.5 | 1634.6 | -822.6 | | | | |
| | 100/11-28-085-21W600 | 662.9 | 1173.5 | -510.6 | 1493.5 | -830.6 | | | | |
| • | 100/06-30-085-21W600 | 847.0 | 1342.9 | -495.9 | 1684.9 | -837.9 | 1707.4 | -860.4 | | |
| • | 100/11-31-085-21W600 | 819.3 | 1316.0 | -496.7 | 1665.0 | -845.7 | 1684.5 | -865.2 | | |
| • | 100/11-32-085-21W600 | 770.5 | 1277.1 | -506.6 | 1606.2 | -835.7 | 1627.6 | -857.1 | | |
| • | 100/10-33-085-21W600 | 699.5 | 1213.7 | -514.2 | 1531.9 | -832.4 | 1554.4 | -854.9 | 1642.8 | -943.3 |
| • | 100/05-01-085-22W600 | 826.0 | 1318.6 | -492.6 | 1672.7 | -846.7 | ? 1692.2 | -866.2 | | |
| • | 100/06-08-085-22W600 | 752.6 | 1297.0 | -544.4 | 1663.0 | -910.4 | ? 1675.0 | -922.4 | | |
| • | 100/11-25-085-22W600 | 823.9 | 1321.9 | -498.0 | 1659.9 | -836.0 | 1681.8 | -857.9 | ? NDE | |
| • | 100/09-36-085-22W600 | 866.5 | 1363.1 | -496.6 | 1692.5 | -826.0 | ? 1708.0 | -841.5 | ? 1730 | -863.5 |
| • | 100/06-02-085-23W600 | 653.8 | 1193.3 | -539.5 | ? 1553.2 | -899.4 | NDE | | | |
| • | 100/06-04-085-23W600 | 662.0 | 1216.0 | -554.0 | 1585.0 | -923.0 | 1640.0 | -978.0 | | |
| • | 100/03-15-085-23W600 | 662.4 | 1205.0 | -542.6 | 1578.0 | -915.6 | 1620.0 | -957.6 | 1732.0 | -1069.6 |
| • | 100/16-19-085-23W600 | 699.5 | 1284.0 | -584.5 | ? 1650.0 | -950.5 | 1684.0 | -984.5 | | |
| • | 100/16-21-085-23W600 | 662.0 | 1203.7 | -541.7 | 1574.5 | -912.5 | NDE | | | |
| • | 100/06-31-085-23W600 | 840.9 | 1435.0 | -594.1 | NDE | | | | | |
| • | 100/06-33-085-23W600 | 670.3 | 1214.3 | -544.0 | 1583.1 | -912.8 | ? NDE | | | |
| • | 100/08-35-085-24W600 | 702.7 | 1363.0 | -660.3 | 1788.5 | -1085.8 | ? 1835.0 | -1132.3 | | |
| • | 100/06-10-085-25W600 | 696.8 | 1359.0 | -662.2 | 1744.5 | -1047.7 | 1771.5 | -1074.7 | ? NDE | |
| • | 100/02-12-085-25W600 | 708.4 | 1271.0 | -562.6 | 1690.9 | -982.5 | 1696.4 | -988.0 | 1829.3 | -1120.9 |
| • | 100/08-13-085-25W600 | 671.4 | 1195.0 | -523.6 | ? 1621.0 | -949.6 | ? 1634.0 | -962.6 | | |
| • | 100/10-18-085-25W600 | 750.1 | 1397.0 | -646.9 | 1802.0 | -1051.9 | 1828.5 | -1078.4 | | |
| • | 100/10-32-085-25W600 | 695.2 | 1375.0 | -679.8 | 1759.0 | -1063.8 | 1803.0 | -1107.8 | 1942.0 | -1246.8 |
| • | 100/06-04-086-19W600 | 710.2 | 1202.0 | -491.8 | 1478.0 | -767.8 | 1488.0 | -777.8 | 1576.0 | -865.8 |
| | 102/11-05-086-19W600 | 762.0 | 1253.6 | -491.6 | 1530.1 | -768.1 | 1560.6 | -798.6 | 1627.6 | -865.6 |
| • | 100/11-07-086-19W600 | 792.5 | 1280.2 | -487.7 | 1558.1 | -765.6 | 1569.9 | -777.4 | 1659.9 | -867.4 |
| • | 100/11-08-086-19W600 | 753.8 | 1243.9 | -490.1 | 1517.2 | -763.4 | 1525.8 | -772.0 | 1612.4 | -858.6 |
| • | 100/11-16-086-19W600 | 676.0 | 1157.9 | -481.9 | 1425.2 | -749.2 | 1436.8 | -760.8 | 1520.3 | -844.3 |
| • | 100/06-17-086-19W600 | 713.5 | 1200.0 | -486.5 | 1473.6 | -760.1 | 1483.4 | -769.9 | 1566.7 | -853.2 |
| • | 100/11-18-086-19W600 | 749.5 | 1233.8 | -484.3 | 1505.6 | -756.1 | 1516.6 | -767.1 | ? 1569.6 | -820.1 |
| • | 100/06-19-086-19W600 | 733.3 | 1210.1 | -476.8 | 1481.3 | -748.0 | 1492.8 | -759.5 | 1575.7 | -842.4 |
| • | 100/11-20-086-19W600 | 692.8 | 1169.0 | -476.2 | 1438.0 | -745.2 | 1448.0 | -755.2 | 1529.0 | -836.2 |
| • | 100/06-28-086-19W600 | 734.7 | 1214.0 | -479.3 | 1479.0 | -744.3 | 1484.0 | -749.3 | 1568.0 | -833.3 |
| • | 100/07-29-086-19W600 | 776.9 | 1258.2 | -481.3 | 1519.0 | -742.1 | 1531.2 | -754.3 | 1611.1 | -834.2 |
| • | 100/07-30-086-19W600 | 695.6 | 1167.4 | -471.8 | 1435.5 | -739.9 | 1446.5 | -750.9 | 1528.8 | -833.2 |
| | 100/14-31-086-19W600 | 742.8 | 1213.1 | -470.3 | 1466.1 | -723.3 | | | | |
| | 100/16-32-086-19W600 | 783.9 | 1263.1 | -479.2 | 1516.1 | -732.2 | 1545.3 | -761.4 | 1605.7 | -821.8 |
| • | 100/10-01-086-20W600 | 800.7 | 1286.9 | -486.2 | 1571.5 | -770.8 | ? 1602.0 | -801.3 | 1677.6 | -876.9 |
| • | 100/02-02-086-20W600 | 786.2 | 1280.0 | -493.8 | 1570.0 | -783.8 | ? 1600.0 | -813.8 | 1679.0 | -892.8 |

| WELL ID | Base Triassic | | 1st Doig Sand | | Thickness | | 2nd Doig Sand | | Thickness | |
|---|---|---|---|---|---|---|---|---|---|---|
| | BLLY | SS | 1st Sand | SS | Sand | Silt Eq. | 2nd Sand | SS | Sand | Silt Eq. |
| 100/14-36-085-20W600 | 1966.0 | -1159.6 | | | | | | | | |
| 100/06-01-085-21W600 | | | 1743.0 | -914.2 | 0.0 | 4.0 | 1723.0 | -894.2 | 0.0 | FS |
| 100/06-03-085-21W600 | | | ?NP | | 0.0 | | 1591.0 | -907.6 | 4.3 | 6.7 |
| 100/06-05-085-21W600 | | | | | | | | | | |
| 100/06-08-085-21W600 | | | NDE | | | | NDE | | | |
| 100/11-10-085-21W600 | | | | | | | | | | |
| 100/14-11-085-21W600 | | | | | | | | | | |
| 100/06-13-085-21W600 | 2070.0 | -1219.9 | ?NP | | 0.0 | | 1743.0 | -892.9 | 2.0 | 7.0 |
| 100/06-14-085-21W600 | 1953.8 | -1226.9 | | | | | | | | |
| 100/11-15-085-21W600 | | | | | | | | | | |
| 100/10-16-085-21W600 | | | ? 1636 | -977.0 | 0.0 | 6.0 | 1604.0 | -945.0 | 10.0 | 19.0 |
| 100/10-18-085-21W600 | | | 1763.2 | -915.2 | 0.0 | 4.6 | 1727.8 | | | 11.0 |
| 100/07-20-085-21W600 | | | 1665.0 | -917.9 | ? | NDE | 1639.5 | -892.4 | 1.5 | |
| 100/10-22-085-21W600 | | | NDE | | | | 1629.4 | -857.6 | 0.9 | 2.7 |
| 100/06-23-085-21W600 | | | ? 1683 | -890.2 | ? | | 1656.2 | -863.4 | | |
| 100/05-27-085-21W600 | | | | | | | | | | |
| 100/11-28-085-21W600 | | | | | | | | | | |
| 100/06-30-085-21W600 | | | ? NDE | | | | | | | |
| 100/11-31-085-21W600 | | | 1735.0 | -915.7 | 2.0 | 7.0 | 1711.0 | -891.7 | 1.0 | 8.0 |
| 100/11-32-085-21W600 | | | NDE | | | | 1649.5 | -879.0 | 0.0 | 4.9 |
| 100/10-33-085-21W600 | 1921.5 | -1222.0 | 1597.1 | -897.6 | 0.0 | 6.1 | 1572.7 | -873.2 | 1.8 | 3.0 |
| 100/05-01-085-22W600 | | | NDE | | | | NDE | | | |
| 100/06-08-085-22W600 | | | | | | | | | | |
| 100/11-25-085-22W600 | | | 1710.5 | -886.6 | ? | 30.5 | | | | |
| 100/09-36-085-22W600 | | | | | | | | | | |
| 100/06-02-085-23W600 | | | | | | | | | | |
| 100/06-04-085-23W600 | | | ? NDE | | | | ? NDE | | | |
| 100/03-15-085-23W600 | 2056.5 | -1394.1 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/16-19-085-23W600 | | | ? NDE | | | | ? NDE | | | |
| 100/16-21-085-23W600 | | | | | | | | | | |
| 100/06-31-085-23W600 | | | | | | | | | | |
| 100/06-33-085-23W600 | | | | | | | | | | |
| 100/08-35-085-24W600 | | | NDE | | | | 1845.0 | -1142.3 | ?4.0 | |
| 100/06-10-085-25W600 | 2242.0 | -1545.2 | NDE | | | | NDE | | | |
| 100/02-12-085-25W600 | 2166.2 | -1457.8 | ? NP | | 0.0 | | 1715.9 | -1007.5 | 0.0 | 9.8 |
| 100/08-13-085-25W600 | | | ? NDE | | | | ? NDE | | | |
| 100/10-18-085-25W600 | | | ? NDE | | | | ? NDE | | | |
| 100/10-32-085-25W600 | 2254.0 | -1558.8 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/06-04-086-19W600 | 1843.0 | -1132.8 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 102/11-05-086-19W600 | 1895.9 | -1133.9 | | | | | | | | |
| 100/11-07-086-19W600 | 1926.3 | -1133.8 | 1598.3 | -805.8 | 0.0 | 14.0 | ? NP | | 0.0 | |
| 100/11-08-086-19W600 | 1878.8 | -1125.0 | ? | | 0.0 | | ? NP | | 0.0 | |
| 100/11-16-086-19W600 | 1786.7 | -1110.7 | NP | | 0.0 | | ? NP | | 0.0 | |
| 100/06-17-086-19W600 | 1835.2 | -1121.7 | 1516.6 | -803.1 | 2.1 | 5.2 | ? NP | | 0.0 | |
| 100/11-18-086-19W600 | 1872.4 | -1122.9 | ? 1542.2 | -792.7 | 0.0 | 12.2 | ? NP | | 0.0 | |
| 100/06-19-086-19W600 | 1849.8 | -1116.5 | 1539.2 | -805.9 | 0.0 | 4.3 | ? NP | | 0.0 | |
| 100/11-20-086-19W600 | 1801.0 | -1108.2 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/06-28-086-19W600 | 1841.0 | -1106.3 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/07-29-086-19W600 | 1883.1 | -1106.2 | NP | | 0.0 | 0.0 | ? NP | | 0.0 | |
| 100/07-30-086-19W600 | 1801.7 | -1106.1 | ? 1476.4 | -780.8 | | 1.8 | ? NP | | 0.0 | |
| 100/14-31-086-19W600 | | | | | | | | | | |
| 100/16-32-086-19W600 | 1874.5 | -1090.6 | | | | | | | | |
| 100/10-01-086-20W600 | 1948.6 | -1147.9 | 1594.0 | -793.3 | 0.0 | 10.4 | ? NP | | 0.0 | |
| 100/02-02-086-20W600 | 1950.0 | -1163.8 | 1623.0 | -836.8 | 0.0 | 13.0 | ? NP | | 0.0 | |

| WELL ID | DOIG<br>GAS | DOIG<br>OIL | CORE | COMMENTS |
|---|---|---|---|---|
| 100/14-36-085-20W600 | | | | |
| 100/06-01-085-21W600 | | | | |
| 100/06-03-085-21W600 | | | | |
| 100/06-05-085-21W600 | | | | |
| 100/06-08-085-21W600 | | | | |
| 100/11-10-085-21W600 | | | | e-log |
| 100/14-11-085-21W600 | | | | e-log |
| 100/06-13-085-21W600 | | | | 2nd Doig sand or stray?? |
| 100/06-14-085-21W600 | | | | SP log |
| 100/11-15-085-21W600 | | ? | | |
| 100/10-16-085-21W600 | | | | |
| 100/10-18-085-21W600 | | | | poor quality log |
| 100/07-20-085-21W600 | | | | |
| 100/10-22-085-21W600 | | | | |
| 100/06-23-085-21W600 | | | | |
| 100/05-27-085-21W600 | | | | no gamma ray log values for DOIG - MNTNY interval |
| 100/11-28-085-21W600 | | | | e-log |
| 100/06-30-085-21W600 | | | | |
| 100/11-31-085-21W600 | | | D | |
| 100/11-32-085-21W600 | | | | |
| 100/10-33-085-21W600 | | | | |
| 100/05-01-085-22W600 | | | | |
| 100/06-08-085-22W600 | | | | |
| 100/11-25-085-22W600 | | | | |
| 100/09-36-085-22W600 | ? | | | |
| 100/06-02-085-23W600 | | | | |
| 100/06-04-085-23W600 | | | | |
| 100/03-15-085-23W600 | | | | |
| 100/16-19-085-23W600 | | | | |
| 100/16-21-085-23W600 | | | | |
| 100/06-31-085-23W600 | | | | |
| 100/06-33-085-23W600 | | | | |
| 100/08-35-085-24W600 | | | | |
| 100/06-10-085-25W600 | | | | |
| 100/02-12-085-25W600 | | | | |
| 100/08-13-085-25W600 | | | | |
| 100/10-18-085-25W600 | | | | |
| 100/10-32-085-25W600 | | | | |
| 100/06-04-086-19W600 | | | | |
| 102/11-05-086-19W600 | | | | e-log |
| 100/11-07-086-19W600 | | | | |
| 100/11-08-086-19W600 | | | | no gamma ray log run through DOIG - MNTNY interval |
| 100/11-16-086-19W600 | | | | |
| 100/06-17-086-19W600 | | | | |
| 100/11-18-086-19W600 | | | | |
| 100/06-19-086-19W600 | | | | |
| 100/11-20-086-19W600 | | | | |
| 100/06-28-086-19W600 | | | | |
| 100/07-29-086-19W600 | | | | |
| 100/07-30-086-19W600 | | | | |
| 100/14-31-086-19W600 | | | | e-log |
| 100/16-32-086-19W600 | | | | e-log |
| 100/10-01-086-20W600 | | | | SB @ base 1st Doig ? |
| 100/02-02-086-20W600 | | | | SB @ base 1st Doig ?: TSE @ 1631.2m |

|  | WELL ID |  | Top Triassic |  | Halfway |  | Doig |  | Montney |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  | KB | BLDN | SS | HLFY | SS | DOIG | SS | MNTN | SS |
| • | 100/04-02-086-20W600 | 788.1 | 1320.0 | -531.9 | 1629.0 | -840.9 | 1656.0 | -867.9 | 1748.0 | -959.9 |
| • | 100/06-02-086-20W600 | 785.6 | 1275.5 | -489.9 | 1566.0 | -780.4 | 1591.0 | -805.4 | 1676.0 | -890.4 |
| • | 100/06-03-086-20W600 | 713.5 | 1197.9 | -484.4 | 1489.8 | -776.3 | 1514.8 | -801.3 | 1596.5 | -883.0 |
| • | 100/08-03-086-20W600 | 700.1 | 1190.0 | -489.9 | 1482.0 | -781.9 | 1506.0 | -805.9 | 1591.0 | -890.9 |
| • | 100/14-03-086-20W600 | 773.2 | 1257.5 | -484.3 | 1552.5 | -779.3 | 1573.0 | -799.8 | 1653.0 | -879.8 |
| • | 100/02-04-086-20W600 | 760.5 | 1248.3 | -487.8 | 1545.7 | -785.2 | 1570.5 | -810.0 | 1652.3 | -891.8 |
| • | 100/06-04-086-20W600 | 754.2 | 1241.0 | -486.8 | 1538.0 | -783.8 | 1563.0 | -808.8 | 1645.0 | -890.8 |
| • | 102/06-04-086-20W600 | 753.0 | 1240.7 | -487.7 | 1538.0 | -785.0 | 1563.0 | -810.0 |  |  |
| • | 100/08-04-086-20W600 | 727.1 | 1211.5 | -484.4 | 1507.0 | -779.9 | 1536.0 | -808.9 | 1612.0 | -884.9 |
| • | 100/12-04-086-20W600 | 743.2 | 1235.0 | -491.8 | 1533.0 | -789.8 | 1558.5 | -815.3 | 1639.0 | -895.8 |
| • | 100/14-04-086-20W600 | 721.0 | 1210.5 | -489.5 | 1507.0 | -786.0 | 1530.0 | -809.0 | 1612.0 | -891.0 |
| • | 100/16-04-086-20W600 | 721.1 | 1208.0 | -486.9 | 1502.0 | -780.9 | 1526.0 | -804.9 | 1605.0 | -883.9 |
| • | 100/08-05-086-20W600 | 794.5 | 1286.0 | -491.5 | 1582.0 | -787.5 | 1609.0 | -814.5 | 1694.0 | -899.5 |
| • | 100/16-05-086-20W600 | 777.5 | 1270.0 | -492.5 | 1567.0 | -789.5 | 1593.0 | -815.5 | 1674.0 | -896.5 |
| • | 100/11-06-086-20W600 | 836.1 | 1338.7 | -502.6 | 1643.4 | -807.3 | 1669.6 | -833.5 | 1749.6 | -913.5 |
| • | 100/06-07-086-20W600 | 830.3 | 1325.3 | -495.0 | 1627.0 | -796.7 | 1660.6 | -830.3 | 1736.1 | -905.8 |
| • | 100/08-07-086-20W600 | 820.0 | 1311.5 | -491.5 | 1612.0 | -792.0 | 1636.0 | -816.0 | 1718.0 | -898.0 |
|  | 100/11-07-086-20W600 | 816.9 | 1309.7 | -492.8 | 1613.5 | -796.6 | 1630.6 | -813.7 | 1722.1 | -905.2 |
| • | 100/07-08-086-20W600 | 766.9 | 1264.9 | -498.0 | 1559.3 | -792.4 | 1575.1 | -808.2 | 1665.7 | -898.8 |
| • | 100/16-08-086-20W600 | 734.0 | 1239.3 | -505.3 | 1523.7 | -789.7 | 1547.0 | -813.0 | 1630.0 | -896.0 |
| • | 100/06-09-086-20W600 | 724.1 | 1217.0 | -492.9 | 1509.0 | -784.9 | 1531.0 | -806.9 | 1616.0 | -891.9 |
| • | 100/08-09-086-20W600 | 747.0 | 1236.0 | -489.0 | 1527.7 | -780.7 | 1549.0 | -802.0 | 1630.0 | -883.0 |
| • | 100/14-09-086-20W600 | 734.9 | 1230.0 | -495.1 | 1518.0 | -783.1 | 1537.0 | -802.1 | 1620.0 | -885.1 |
| • | 100/11-10-086-20W600 | 812.0 | 1298.4 | -486.4 | 1582.5 | -770.5 | 1605.4 | -793.4 | 1688.0 | -876.0 |
| • | 100/10-11-086-20W600 | 765.4 | 1251.5 | -486.1 | 1539.2 | -773.8 | 1551.1 | -785.7 | 1640.4 | -875.0 |
| • | 100/10-12-086-20W600 | 797.7 | 1279.6 | -481.9 | 1561.4 | -763.7 | 1573.9 | -776.2 | 1663.5 | -865.8 |
| • | 100/02-13-086-20W600 | 800.4 | 1280.2 | -479.8 | 1560.6 | -760.2 | 1584.0 | -783.6 | 1658.7 | -858.3 |
| • | 100/06-14-086-20W600 | 760.1 | 1245.7 | -485.6 | 1524.0 | -763.9 | 1550.0 | -789.9 | 1626.0 | -865.9 |
| • | 100/07-14-086-20W600 | 777.2 | 1253.9 | -476.7 | 1533.8 | -756.6 | 1557.5 | -780.3 | 1634.9 | -857.7 |
| • | 100/08-14-086-20W600 | 792.2 | 1271.0 | -478.8 | 1550.0 | -757.8 | 1575.0 | -782.8 | 1650.0 | -857.8 |
| • | 100/06-15-086-20W600 | 799.5 | 1286.3 | -486.8 | 1564.0 | -764.5 | 1585.0 | -785.5 | 1668.5 | -869.0 |
| • | 100/08-15-086-20W600 | 742.9 | 1229.3 | -486.4 | 1509.5 | -766.6 | 1530.0 | -787.1 | 1612.7 | -869.8 |
| • | 100/16-15-086-20W600 | 733.7 | 1219.7 | -486.0 | 1495.3 | -761.6 | 1517.0 | -783.3 | 1600.0 | -866.3 |
| • | 100/06-16-086-20W600 | 774.3 | 1265.0 | -490.7 | 1554.0 | -779.7 | 1573.0 | -798.7 | 1656.0 | -881.7 |
| • | 100/08-16-086-20W600 | 794.9 | 1279.5 | -484.6 | 1570.0 | -775.1 | 1580.0 | -785.1 | 1673.0 | -878.1 |
| • | 100/06-17-086-20W600 | 739.7 | 1235.0 | -495.3 | 1529.4 | -789.7 | 1550.7 | -811.0 | 1634.9 | -895.2 |
| • | 100/11-17-086-20W600 | 733.7 | 1226.0 | -492.3 | 1522.0 | -788.3 | 1543.0 | -809.3 | 1627.0 | -893.3 |
|  | 100/10-18-086-20W600 | 773.9 | 1261.9 | -488.0 | 1564.2 | -790.3 | 1598.7 | -824.8 | 1674.9 | -901.0 |
| • | 100/11-19-086-20W600 | 748.3 | 1239.9 | -491.6 | 1536.1 | -787.8 | 1555.6 | -807.3 | 1610.5 | -862.2 |
| • | 100/11-20-086-20W600 | 732.4 | 1224.4 | -492.0 | 1514.8 | -782.4 | 1528.2 | -795.8 | 1619.6 | -887.2 |
| • | 100/11-21-086-20W600 | 822.9 | 1311.0 | -488.1 | 1601.0 | -778.1 | 1616.0 | -793.1 | 1701.0 | -878.1 |
| • | 100/06-22-086-20W600 | 772.1 | 1254.6 | -482.5 | 1534.9 | -762.8 | 1548.3 | -776.2 | 1639.7 | -867.6 |
| • | 102/06-22-086-20W600 | 784.9 | 1270.2 | -485.3 | 1550.0 | -765.1 | 1563.0 | -778.1 | 1655.0 | -870.1 |
| • | 100/07-23-086-20W600 | 791.6 | 1270.1 | -478.5 | 1549.5 | -757.9 | 1562.3 | -770.7 | 1647.7 | -856.1 |
| • | 100/04-24-086-20W600 | 798.0 | 1272.2 | -474.2 | 1547.7 | -749.7 | 1560.5 | -762.5 | 1645.8 | -847.8 |
| • | 100/10-25-086-20W600 | 734.3 | 1204.0 | -469.7 | 1474.0 | -739.7 | 1486.5 | -752.2 | 1569.7 | -835.4 |
| • | 100/07-26-086-20W600 | 798.6 | 1282.0 | -483.4 | 1550.0 | -751.4 | 1563.0 | -764.4 | 1646.5 | -847.9 |
| • | 100/02-28-086-20W600 | 811.1 | 1297.5 | -486.4 | 1582.4 | -771.3 | 1591.6 | -780.5 | 1682.4 | -871.3 |
| • | 100/06-28-086-20W600 | 825.1 | 1318.0 | -492.9 | 1600.7 | -775.6 | 1610.0 | -784.9 | 1699.0 | -873.9 |
| • | 100/10-28-086-20W600 | 812.3 | 1299.4 | -487.1 | 1583.7 | -771.4 | 1597.7 | -785.4 | 1680.6 | -868.3 |
| • | 100/11-30-086-20W600 | 793.1 | 1283.2 | -490.1 | 1581.8 | -788.7 | 1598.3 | -805.2 | 1685.5 | -892.4 |
| • | 100/10-31-086-20W600 | 805.7 | 1308.5 | -502.8 | 1594.3 | -788.6 | 1614.5 | -808.8 | 1694.0 | -888.3 |
| • | 100/11-32-086-20W600 | 758.0 | 1262.8 | -504.8 | 1542.5 | -784.5 | 1554.4 | -796.4 | 1643.4 | -885.4 |
| • | 100/06-33-086-20W600 | 806.2 | 1300.0 | -493.8 | 1582.5 | -776.3 | 1600.0 | -793.8 | 1679.0 | -872.8 |

| WELL ID | Base Triassic | | 1st Doig Sand | | Thickness | | 2nd Doig Sand | | Thickness | |
|---|---|---|---|---|---|---|---|---|---|---|
| | BLLY | SS | 1st Sand | SS | Sand | Silt Eq. | 2nd Sand | SS | Sand | Silt Eq. |
| 100/04-02-086-20W600 | 2029.0 | -1240.9 | 1688.0 | -899.9 | 1.0 | 11.0 | ? NP | | 0.0 | |
| 100/06-02-086-20W600 | 1945.5 | -1159.9 | 1619.0 | -833.4 | 1.0 | 14.0 | ? NP | | 0.0 | |
| 100/06-03-086-20W600 | 1869.0 | -1155.5 | 1543.7 | -830.2 | 2.4 | 10.1 | ? NP | | 0.0 | |
| 100/08-03-086-20W600 | 1857.0 | -1156.9 | 1535.0 | -834.9 | ? 10.0 | 10.0 | ? NP | | 0.0 | |
| 100/14-03-086-20W600 | 1931.0 | -1157.8 | 1601.5 | -828.3 | ? | 9.5 | ? NP | | 0.0 | |
| 100/02-04-086-20W600 | 1928.0 | -1167.5 | 1601.0 | -840.5 | trace | 12.0 | ? NP | | 0.0 | |
| 100/06-04-086-20W600 | 1921.0 | -1166.8 | 1590.0 | -835.8 | ? 6.0 | 21.0 | ? NP | | 0.0 | |
| 102/06-04-086-20W600 | | | 1590.0 | -837.0 | 6.0 | 21.0 | | | | |
| 100/08-04-086-20W600 | 1885.5 | -1158.4 | 1554.0 | -826.9 | trace | 13.0 | ? NP | | 0.0 | |
| 100/12-04-086-20W600 | 1917.0 | -1173.8 | 1585.0 | -841.8 | 6.5 | 20.0 | ? NP | | 0.0 | |
| 100/14-04-086-20W600 | 1890.0 | -1169.0 | 1557.0 | -836.0 | 4.5 | 18.0 | ? NP | | 0.0 | |
| 100/16-04-086-20W600 | 1883.0 | -1161.9 | 1550.0 | -828.9 | 3.0 | 21.0 | ? NP | | 0.0 | |
| 100/08-05-086-20W600 | 1970.0 | -1175.5 | 1640.0 | -845.5 | 6.0 | 22.0 | ? NP | | 0.0 | |
| 100/16-05-086-20W600 | 1952.0 | -1174.5 | 1620.0 | -842.5 | ? | 13.0 | ? NP | | 0.0 | |
| 100/11-06-086-20W600 | 2030.9 | -1194.8 | 1699.5 | -863.4 | 0.0 | > 7.3 | ? NP | | 0.0 | |
| 100/06-07-086-20W600 | 2017.8 | -1187.5 | 1683.0 | -852.7 | 0.0 | 9.8 | ? NP | | 0.0 | |
| 100/08-07-086-20W600 | 1996.0 | -1176.0 | 1667.0 | -847.0 | 0.0 | 10.0 | ? NP | | 0.0 | |
| 100/11-07-086-20W600 | 2001.3 | -1184.4 | | | | | | | | |
| 100/07-08-086-20W600 | 1945.8 | -1178.9 | 1612.3 | -845.4 | ? 2.4 | 10.7 | ? NP | | 0.0 | |
| 100/16-08-086-20W600 | 1908.0 | -1174.0 | 1575.0 | -841.0 | trace | 12.0 | ? NP | | 0.0 | |
| 100/06-09-086-20W600 | 1890.5 | -1166.4 | 1555.0 | -830.9 | trace | 14.0 | ? NP | | 0.0 | |
| 100/08-09-086-20W600 | 1905.0 | -1158.0 | 1577.0 | -830.0 | 1.0 | 12.0 | ? NP | | 0.0 | |
| 100/14-09-086-20W600 | 1896.0 | -1161.1 | 1565.0 | -830.1 | 3.0 | 10.5 | ? NP | | 0.0 | |
| 100/11-10-086-20W600 | 1963.5 | -1151.5 | 1632.2 | -820.2 | 7.3 | 22.2 | ? NP | | 0.0 | |
| 100/10-11-086-20W600 | 1912.8 | -1147.4 | 1585.5 | -820.1 | 1.2 | 9.8 | ? NP | | 0.0 | |
| 100/10-12-086-20W600 | 1934.9 | -1137.2 | 1605.3 | -807.6 | 0.0 | 5.8 | ? NP | | 0.0 | |
| 100/02-13-086-20W600 | 1933.0 | -1132.6 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/06-14-086-20W600 | | | 1569.5 | -809.4 | 1.5 | 9.5 | ? NP | | 0.0 | |
| 100/07-14-086-20W600 | 1907.7 | -1130.5 | 1577.0 | -799.8 | 3.4 | 13.4 | ? NP | | 0.0 | |
| 100/08-14-086-20W600 | | | 1593.5 | -801.3 | 1.0 | 11.0 | ? NP | | 0.0 | |
| 100/06-15-086-20W600 | 1944.0 | -1144.5 | 1616.0 | -816.5 | 4.0 | 15.0 | ? NP | | 0.0 | |
| 100/08-15-086-20W600 | | | 1555.0 | -812.1 | trace | 20.0 | ? NP | | 0.0 | |
| 100/16-15-086-20W600 | | | 1542.0 | -808.3 | 2.0 | 11.0 | ? NP | | 0.0 | |
| 100/06-16-086-20W600 | 1932.0 | -1157.7 | 1601.0 | -826.7 | ? 4.0 | 12.0 | ? NP | | 0.0 | |
| 100/08-16-086-20W600 | 1948.0 | -1153.1 | 1614.0 | -819.1 | 3.0 | 11.0 | ? NP | | 0.0 | |
| 100/06-17-086-20W600 | 1912.0 | -1172.3 | 1580.6 | -840.9 | 4.3 | 9.8 | ? NP | | 0.0 | |
| 100/11-17-086-20W600 | 1905.0 | -1171.3 | 1572.0 | -838.3 | 0.0 | 9.0 | ? NP | | 0.0 | |
| 100/10-18-086-20W600 | 1944.0 | -1170.1 | | | | | | | | |
| 100/11-19-086-20W600 | 1916.6 | -1168.3 | 1584.3 | -836.0 | 3.7 | 5.5 | ? NP | | 0.0 | |
| 100/11-20-086-20W600 | 1892.8 | -1160.4 | 1562.3 | -829.9 | 0.0 | 6.1 | ? NP | | 0.0 | |
| 100/11-21-086-20W600 | 1975.0 | -1152.1 | 1642.0 | -819.1 | 1.5 | 7.5 | ? NP | | 0.0 | |
| 100/06-22-086-20W600 | 1918.1 | -1146.0 | 1580.0 | -807.9 | ? 3.0 | 11.0 | ? NP | | 0.0 | |
| 102/06-22-086-20W600 | 1934.0 | -1149.1 | 1595.0 | -810.1 | 3.5 | 11.0 | ? NP | | 0.0 | |
| 100/07-23-086-20W600 | 1923.6 | -1132.0 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/04-24-086-20W600 | 1920.8 | -1122.8 | ? 1591.6 | -793.6 | 0.0 | 10.4 | ? NP | | 0.0 | |
| 100/10-25-086-20W600 | 1842.5 | -1108.2 | 1513.0 | -778.7 | ? | | ? NP | | 0.0 | |
| 100/07-26-086-20W600 | 1921.0 | -1122.4 | 1588.5 | -789.9 | trace | 7.5 | ? NP | | 0.0 | |
| 100/02-28-086-20W600 | 1953.8 | -1142.7 | 1622.7 | -811.6 | 0.0 | 5.2 | ? NP | | 0.0 | |
| 100/06-28-086-20W600 | 1970.0 | -1144.9 | 1640.0 | -814.9 | 0.0 | 4.5 | ? NP | | 0.0 | |
| 100/10-28-086-20W600 | 1950.4 | -1138.1 | 1622.1 | -809.8 | 1.2 | 4.3 | ? NP | | 0.0 | |
| 100/11-30-086-20W600 | 1956.8 | -1163.7 | 1626.9 | -833.8 | ? silty | 4.9 | ? NP | | 0.0 | |
| 100/10-31-086-20W600 | 1965.0 | -1159.3 | 1636.0 | -830.3 | 0.0 | 4.0 | ? NP | | 0.0 | |
| 100/11-32-086-20W600 | 1913.5 | -1155.5 | 1583.1 | -825.1 | 2.7 | 3.7 | ? NP | | 0.0 | |
| 100/06-33-086-20W600 | 1949.0 | -1142.8 | 1618.0 | -811.8 | 2.0 | 4.0 | ? NP | | 0.0 | |

| WELL ID | DOIG GAS | DOIG OIL | CORE | COMMENTS |
|---|---|---|---|---|
| 100/04-02-086-20W600 | | | | SB @ base 1st Doig ?: TSE @ 1634.5m |
| 100/06-02-086-20W600 | | | | |
| 100/06-03-086-20W600 | | | | SB @ base 1st Doig ? |
| 100/08-03-086-20W600 | | | | SB @ base 1st Doig ? |
| 100/14-03-086-20W600 | | | | SB @ base 1st Doig ?: TSE @ 1543m |
| 100/02-04-086-20W600 | | | | |
| 100/06-04-086-20W600 | | | | SB @ base 1st Doig ? |
| 102/06-04-086-20W600 | | X | D | SB @ base 1st Doig ? |
| 100/08-04-086-20W600 | | | | SB @ base 1st Doig ? |
| 100/12-04-086-20W600 | | X | D | SB @ base 1st Doig ? |
| 100/14-04-086-20W600 | | | | SB @ base 1st Doig ? |
| 100/16-04-086-20W600 | | X | | SB @ base 1st Doig ? |
| 100/08-05-086-20W600 | | X | | SB @ base 1st Doig ? |
| 100/16-05-086-20W600 | | | | |
| 100/11-06-086-20W600 | | | | |
| 100/06-07-086-20W600 | | | | |
| 100/08-07-086-20W600 | | | | |
| 100/11-07-086-20W600 | | | | |
| 100/07-08-086-20W600 | | | | |
| 100/16-08-086-20W600 | | | | |
| 100/06-09-086-20W600 | | | | |
| 100/08-09-086-20W600 | | | | |
| 100/14-09-086-20W600 | | | | |
| 100/11-10-086-20W600 | | | | |
| 100/10-11-086-20W600 | | | | |
| 100/10-12-086-20W600 | | | | |
| 100/02-13-086-20W600 | | | | e-log |
| 100/06-14-086-20W600 | | X | | |
| 100/07-14-086-20W600 | | | | |
| 100/08-14-086-20W600 | | ? | | |
| 100/06-15-086-20W600 | | | | |
| 100/08-15-086-20W600 | | | | |
| 100/16-15-086-20W600 | | | D | |
| 100/06-16-086-20W600 | | | | |
| 100/08-16-086-20W600 | | | | |
| 100/06-17-086-20W600 | | | | |
| 100/11-17-086-20W600 | | | | |
| 100/10-18-086-20W600 | | | | |
| 100/11-19-086-20W600 | | | | |
| 100/11-20-086-20W600 | | | | |
| 100/11-21-086-20W600 | | | | |
| 100/06-22-086-20W600 | | | | |
| 102/06-22-086-20W600 | | | | |
| 100/07-23-086-20W600 | | | | |
| 100/04-24-086-20W600 | | | | |
| 100/10-25-086-20W600 | | | HD | |
| 100/07-26-086-20W600 | | | | |
| 100/02-28-086-20W600 | | | | |
| 100/06-28-086-20W600 | | | | |
| 100/10-28-086-20W600 | | | | |
| 100/11-30-086-20W600 | | | | |
| 100/10-31-086-20W600 | | | | |
| 100/11-32-086-20W600 | | | | |
| 100/06-33-086-20W600 | | | | |

| | WELL ID | | Top Triassic | | Halfway | | Doig | | Montney | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | KB | BLDN | SS | HLFY | SS | DOIG | SS | MNTN | SS |
| • | 100/07-33-086-20W600 | 791.0 | 1283.0 | -492.0 | 1564.0 | -773.0 | 1575.0 | -784.0 | | |
| • | 100/06-35-086-20W600 | 774.8 | 1255.5 | -480.7 | 1520.3 | -745.5 | 1533.1 | -758.3 | 1616.0 | -841.2 |
| • | 100/16-01-086-21W600 | 823.4 | 1320.0 | -496.6 | 1625.0 | -801.6 | 1653.0 | -829.6 | 1739.0 | -915.6 |
| • | 100/07-03-086-21W600 | 813.5 | 1318.0 | -504.5 | 1635.5 | -822.0 | 1659.3 | -845.8 | | |
| • | 100/11-07-086-21W600 | 819.9 | 1326.0 | -506.1 | 1652.0 | -832.1 | 1668.0 | -848.1 | | |
| • | 100/11-08-086-21W600 | 803.1 | 1307.9 | -504.8 | 1632.4 | -829.3 | 1650.7 | -847.6 | | |
| • | 100/06-09-086-21W600 | 678.5 | 1197.6 | -519.1 | 1516.9 | -838.4 | 1536.7 | -858.2 | ? 1625.8 | -947.3 |
| • | 100/16-10-086-21W600 | 830.6 | 1336.9 | -506.3 | 1643.7 | -813.1 | 1660.8 | -830.2 | | |
| | 100/08-11-086-21W600 | 840.9 | 1332.0 | -491.1 | 1640.7 | -799.8 | 1668.5 | -827.6 | 1748.9 | -908.0 |
| • | 100/11-11-086-21W600 | 832.4 | 1332.3 | -499.9 | 1641.6 | -809.2 | 1658.0 | -825.6 | 1750.1 | -917.7 |
| • | 100/06-12-086-21W600 | 844.1 | 1331.0 | -486.9 | 1639.5 | -795.4 | 1662.0 | -817.9 | 1750.0 | -905.9 |
| • | 100/10-12-086-21W600 | 818.1 | 1306.7 | -488.6 | 1607.4 | -789.3 | 1636.7 | -818.6 | 1719.7 | -901.6 |
| • | 100/06-13-086-21W600 | 808.0 | 1300.0 | -492.0 | 1600.0 | -792.0 | 1626.0 | -818.0 | 1710.0 | -902.0 |
| • | 100/08-13-086-21W600 | 784.9 | 1278.9 | -494.0 | 1579.4 | -794.5 | 1594.6 | -809.7 | 1686.1 | -901.2 |
| • | 100/14-14-086-21W600 | 859.0 | 1354.5 | -495.5 | 1660.0 | -801.0 | 1680.0 | -821.0 | 1765.0 | -906.0 |
| • | 100/16-16-086-21W600 | 801.6 | 1315.3 | -513.7 | 1624.0 | -822.4 | 1641.0 | -839.4 | 1732.5 | -930.9 |
| • | 100/11-18-086-21W600 | 835.0 | 1351.0 | -516.0 | 1669.0 | -834.0 | 1685.5 | -850.5 | 1782.0 | -947.0 |
| • | 100/06-22-086-21W600 | 818.4 | 1325.0 | -506.6 | 1632.0 | -813.6 | 1647.5 | -829.1 | 1739.0 | -920.6 |
| | 100/04-23-086-21W600 | 849.2 | 1347.2 | -498.0 | 1652.0 | -802.8 | 1674.0 | -824.8 | 1758.4 | -909.2 |
| • | 100/10-24-086-21W600 | 790.0 | 1285.0 | -495.0 | 1590.1 | -800.1 | 1609.3 | -819.3 | 1694.6 | -904.6 |
| • | 100/11-25-086-21W600 | 809.9 | 1305.0 | -495.1 | 1605.0 | -795.1 | 1624.0 | -814.1 | 1709.0 | -899.1 |
| • | 100/10-26-086-21W600 | 836.2 | 1325.0 | -488.8 | 1620.0 | -783.8 | 1640.0 | -803.8 | 1725.0 | -888.8 |
| • | 100/10-27-086-21W600 | 845.5 | 1350.0 | -504.5 | 1652.5 | -807.0 | 1669.0 | -823.5 | 1756.0 | -910.5 |
| • | 100/06-28-086-21W600 | 733.9 | 1250.0 | -516.1 | 1558.0 | -824.1 | 1574.0 | -840.1 | 1666.0 | -932.1 |
| • | 100/10-30-086-21W600 | 826.0 | 1345.5 | -519.5 | 1654.0 | -828.0 | 1674.0 | -848.0 | 1761.0 | -935.0 |
| • | 100/10-34-086-21W600 | 844.6 | 1348.0 | -503.4 | 1644.0 | -799.4 | 1664.0 | -819.4 | 1750.0 | -905.4 |
| | 100/10-35-086-21W600 | 822.3 | 1306.7 | -484.4 | 1600.0 | -777.7 | 1625.0 | -802.7 | 1705.5 | -883.2 |
| • | 100/10-36-086-21W600 | 772.6 | 1272.5 | -499.9 | 1566.0 | -793.4 | 1587.0 | -814.4 | 1667.5 | -894.9 |
| • | 100/07-01-086-22W600 | 805.3 | 1300.9 | -495.6 | ? 1628.2 | -822.9 | NDE | | | |
| • | 100/02-02-086-22W600 | 698.0 | 1219.2 | -521.2 | ? 1577.0 | -879.0 | NDE | | | |
| • | 100/07-06-086-22W600 | 839.4 | 1390.0 | -550.6 | 1736.0 | -896.6 | 1774.0 | -934.6 | 1876.0 | -1036.6 |
| • | 100/10-12-086-22W600 | 847.3 | 1343.0 | -495.7 | 1667.0 | -819.7 | 1690.0 | -842.7 | 1784.0 | -936.7 |
| | 100/11-12-086-22W600 | 839.4 | 1334.1 | -494.7 | 1649.6 | -810.2 | | | | |
| • | 100/10-14-086-22W600 | 837.3 | 1350.3 | -513.0 | 1686.1 | -848.8 | NDE | | | |
| • | 100/13-16-086-22W600 | 856.5 | 1373.7 | -517.2 | 1703.1 | -846.6 | ? 1737.3 | -880.8 | | |
| • | 100/07-24-086-22W600 | 869.6 | 1380.7 | -511.1 | 1698.7 | -829.1 | 1721.2 | -851.6 | | |
| • | 100/07-25-086-22W600 | 892.0 | 1425.0 | -533.0 | 1721.0 | -829.0 | 1753.0 | -861.0 | 1842.0 | -950.0 |
| | 100/09-26-086-22W600 | 813.9 | 1327.0 | -513.1 | 1649.0 | -835.1 | 1666.0 | -852.1 | 1756.0 | -942.1 |
| • | 100/06-32-086-22W600 | 833.3 | 1352.0 | -518.7 | 1667.0 | -833.7 | 1703.0 | -869.7 | 1796.0 | -962.7 |
| • | 100/10-35-086-22W600 | 773.0 | 1310.0 | -537.0 | 1619.0 | -846.0 | 1650.0 | -877.0 | | |
| | 100/04-03-086-23W600 | 699.6 | 1237.0 | -537.4 | 1603.0 | -903.4 | 1646.0 | -946.4 | | |
| | 100/06-09-086-23W600 | 671.2 | 1209.8 | -538.6 | 1565.5 | -894.3 | 1610.6 | -939.4 | | |
| | 100/06-15-086-23W600 | 679.7 | 1241.5 | -561.8 | 1569.7 | -890.0 | 1630.7 | -951.0 | | |
| | 100/07-16-086-23W600 | 772.4 | 1316.7 | -544.3 | 1664.2 | -891.8 | 1705.7 | -933.3 | 1814.2 | -1041.8 |
| | 100/06-17-086-23W600 | 743.7 | 1307.9 | -564.2 | 1642.9 | -899.2 | | | | |
| | 102/06-32-086-23W600 | 717.2 | 1244.0 | -526.8 | 1582.0 | -864.8 | 1625.0 | -907.8 | | |
| | 100/06-33-086-23W60C | 786.1 | 1350.0 | -563.9 | 1691.0 | -904.9 | 1733.0 | -946.9 | | |
| | 100/14-02-086-24W600 | 687.6 | 1254.0 | -566.4 | 1618.5 | -930.9 | 1676.0 | -988.4 | 1786.0 | -1098.4 |
| | 100/07-05-086-24W600 | 670.6 | 1313.7 | -643.1 | 1681.9 | -1011.3 | 1749.6 | -1079.0 | | |
| | 100/03-11-086-24W600 | 670.0 | 1240.0 | -570.0 | 1610.0 | -940.0 | 1667.0 | -997.0 | | |
| | 100/10-11-086-24W600 | 897.0 | 1480.7 | -583.7 | 1837.6 | -940.6 | | | | |
| | 100/16-12-086-24W600 | 714.5 | 1315.5 | -601.0 | 1674.0 | -959.5 | | | | |
| | 100/06-14-086-24W600 | 849.0 | 1447.0 | -598.0 | 1807.5 | -958.5 | 1861.0 | -1012.0 | | |
| | 100/10-32-086-24W600 | 640.1 | 1300.6 | -660.5 | 1641.3 | -1001.2 | | | | |

| WELL ID | Base Triassic | | 1st Doig Sand | | Thickness | | 2nd Doig Sand | | Thickness | |
|---|---|---|---|---|---|---|---|---|---|---|
| | BLLY | SS | 1st Sand | SS | Sand | Silt Eq. | 2nd Sand | SS | Sand | Silt Eq. |
| 100/07-33-086-20W600 | | | 1602.0 | -811.0 | 0.0 | 2.0 | ? NDE | | | |
| 100/06-35-086-20W600 | 1890.4 | -1115.6 | 1558.1 | -783.3 | 0.0 | 0.9 | ? NP | | 0.0 | |
| 100/16-01-086-21W600 | 2017.0 | -1193.6 | 1688.0 | -864.6 | 3.0 | 9.0 | ? NP | | 0.0 | |
| 100/07-03-086-21W600 | | | 1693.4 | -879.9 | 0.0 | 9.1 | 1670.2 | -856.7 | 0.0 | 4.9 |
| 100/11-07-086-21W600 | | | NDE | | | | 1686.0 | -866.1 | | ? NDE |
| 100/11-08-086-21W600 | | | NDE | | | | 1666.6 | -863.5 | 4.9 | ? 12.2 |
| 100/06-09-086-21W600 | 1905.0 | -1226.5 | ? | | | | ? | | | |
| 100/16-10-086-21W600 | | | NDE | | | | | | | |
| 100/08-11-086-21W600 | 2026.3 | -1185.4 | ? | | | | ? | | | |
| 100/11-11-086-21W600 | 2021.1 | -1188.7 | ? NP | | 0.0 | | 1700.1 | -867.7 | 1.2 | 7.3 |
| 100/06-12-086-21W600 | 2026.7 | -1182.6 | ? NP | | 0.0 | | 1697.0 | -852.9 | 5.5 | 9.5 |
| 100/10-12-086-21W600 | 2002.5 | -1184.4 | ? NP | | 0.0 | | 1667.2 | -849.1 | 3.0 | 9.8 |
| 100/06-13-086-21W600 | 1990.0 | -1182.0 | ? NP | | 0.0 | | 1655.5 | -847.5 | 7.5 | 10.0 |
| 100/08-13-086-21W600 | 1965.7 | -1180.8 | ? NP | | 0.0 | | 1633.6 | -848.7 | 1.8 | 9.8 |
| 100/14-14-086-21W600 | 2037.0 | -1178.0 | ? NP | | 0.0 | | 1710.5 | -851.5 | 0.0 | 8.5 |
| 100/16-16-086-21W600 | 2010.1 | -1208.5 | ? NP | | 0.0 | | 1679.0 | -877.4 | 0.0 | 9.0 |
| 100/11-18-086-21W600 | 2056.5 | -1221.5 | ? NP | | 0.0 | | 1727.5 | -892.5 | 3.0 | 9.0 |
| 100/06-22-086-21W600 | 2011.0 | -1192.6 | ? NP | | 0.0 | | 1686.0 | -867.6 | 1.0 | 7.0 |
| 100/04-23-086-21W600 | 2033.0 | -1183.8 | | | | | | | | |
| 100/10-24-086-21W600 | 1971.8 | -1181.8 | ? NP | | 0.0 | | 1637.9 | -847.9 | 1.2 | 6.7 |
| 100/11-25-086-21W600 | 1983.0 | -1173.1 | ? NP | | 0.0 | | 1652.0 | -842.1 | 2.0 | 4.5 |
| 100/10-26-086-21W600 | 2004.0 | -1167.8 | ? NP | | 0.0 | | 1669.0 | -832.8 | 1.5 | 4.0 |
| 100/10-27-086-21W600 | 2033.0 | -1187.5 | ? NP | | 0.0 | | 1701.0 | -855.5 | trace | 6.0 |
| 100/06-28-086-21W600 | 1940.3 | -1206.4 | ? NP | | 0.0 | | 1610.0 | -876.1 | 2.0 | 7.0 |
| 100/10-30-086-21W600 | 2030.0 | -1204.0 | ? NP | | 0.0 | | 1704.5 | -878.5 | 0.0 | 4.5 |
| 100/10-34-086-21W600 | 2025.0 | -1180.4 | ? NP | | 0.0 | | 1692.0 | -847.4 | 1.5 | 5.0 |
| 100/10-35-086-21W600 | 1982.0 | -1159.7 | | | | | | | | |
| 100/10-36-086-21W600 | 1936.0 | -1163.4 | ? NP | | 0.0 | | 1609.0 | -836.4 | ? 4.0 | 5.0 |
| 100/07-01-086-22W600 | | | | | | | | | | |
| 100/02-02-086-22W600 | | | | | | | | | | |
| 100/07-06-086-22W600 | 2161.0 | -1321.6 | ?NP | | 0.0 | | 1824.0 | -984.6 | 0.5 | 8.0 |
| 100/10-12-086-22W600 | 2070.0 | -1222.7 | 1734.0 | -886.7 | 0.0 | 8.0 | 1706.0 | -858.7 | 7.0 | 10.0 |
| 100/11-12-086-22W600 | | | | | | | | | | |
| 100/10-14-086-22W600 | | | | | | | | | | |
| 100/13-16-086-22W600 | | | NDE | | | | NDE | | | |
| 100/07-24-086-22W600 | | | NDE | | | | NDE | | - | |
| 100/07-25-086-22W600 | 2120.0 | -1228.0 | 1785.5 | -893.5 | trace | 5.0 | ? NP | | 0.0 | |
| 100/09-26-086-22W600 | 2033.0 | -1219.1 | | | | | | | | |
| 100/06-32-086-22W600 | 2075.0 | -1241.7 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/10-35-086-22W600 | | | | | | | ? 1681 | -908.0 | 0.0 | 5.0 |
| 100/04-03-086-23W600 | | | | | | | | | | |
| 100/06-09-086-23W600 | | | | | | | | | | |
| 100/06-15-086-23W600 | | | | | | | | | | |
| 100/07-16-086-23W600 | 2121.4 | -1349.0 | | | | | | | | |
| 100/06-17-086-23W600 | | | | | | | | | | |
| 102/06-32-086-23W600 | | | | | | | | | | |
| 100/06-33-086-23W600 | | | | | | | | | | |
| 100/14-02-086-24W600 | 2112.0 | -1424.4 | | | | | | | | |
| 100/07-05-086-24W600 | | | | | | | | | | |
| 100/03-11-086-24W600 | | | | | | | | | | |
| 100/10-11-086-24W600 | | | | | | | | | | |
| 100/16-12-086-24W600 | | | | | | | | | | |
| 100/06-14-086-24W600 | | | | | | | | | | |
| 100/10-32-086-24W600 | | | | | | | | | | |

| WELL ID | DOIG GAS | DOIG OIL | CORE | COMMENTS |
|---|---|---|---|---|
| 100/07-33-086-20W600 | | | | |
| 100/06-35-086-20W600 | | | | |
| 100/16-01-086-21W600 | | | | |
| 100/07-03-086-21W600 | | | | |
| 100/11-07-086-21W600 | | | | |
| 100/11-08-086-21W600 | | | | |
| 100/06-09-086-21W600 | | | | no gamma ray log run through DOIG - MNTNY interval |
| 100/16-10-086-21W600 | | | | |
| 100/08-11-086-21W600 | | | | e-log |
| 100/11-11-086-21W600 | | | | |
| 100/06-12-086-21W600 | | | | |
| 100/10-12-086-21W600 | | | | |
| 100/06-13-086-21W600 | | | | |
| 100/08-13-086-21W600 | | | | |
| 100/14-14-086-21W600 | | | | |
| 100/16-16-086-21W600 | | | | |
| 100/11-18-086-21W600 | | | | Sand at base 1st Doig Eq. TSE? @ 1697m (Subsea: -862m) |
| 100/06-22-086-21W600 | | | | Sand at base 1st Doig Eq. |
| 100/04-23-086-21W600 | | | | e-log |
| 100/10-24-086-21W600 | | | | Sand at base 1st Doig Eq. |
| 100/11-25-086-21W600 | | | | Sand at base 1st Doig Eq. |
| 100/10-26-086-21W600 | | | | Sand at base 1st Doig Eq. |
| 100/10-27-086-21W600 | | | | Trace sand at base 1st Doig Eq. |
| 100/06-28-086-21W600 | | | | Sand at base 1st Doig Eq. |
| 100/10-30-086-21W600 | | | | |
| 100/10-34-086-21W600 | | | | |
| 100/10-35-086-21W600 | | | | |
| 100/10-36-086-21W600 | | | | |
| 100/07-01-086-22W600 | | | | |
| 100/02-02-086-22W600 | | | | |
| 100/07-06-086-22W600 | | | | |
| 100/10-12-086-22W600 | | | | |
| 100/11-12-086-22W600 | | | | e-log |
| 100/10-14-086-22W600 | | | | |
| 100/13-16-086-22W600 | | | | |
| 100/07-24-086-22W600 | | | | |
| 100/07-25-086-22W600 | | | | |
| 100/09-26-086-22W600 | | | | no fiche available |
| 100/06-32-086-22W600 | | | | |
| 100/10-35-086-22W600 | | | | |
| 100/04-03-086-23W600 | | | | |
| 100/06-09-086-23W600 | | | | |
| 100/06-15-086-23W600 | | | | |
| 100/07-16-086-23W600 | | | | |
| 100/06-17-086-23W600 | | | | |
| 102/06-32-086-23W600 | | | | |
| 100/06-33-086-23W600 | | | | |
| 100/14-02-086-24W600 | | | | |
| 100/07-05-086-24W600 | | | | |
| 100/03-11-086-24W600 | | | | |
| 100/10-11-086-24W600 | | | | |
| 100/16-12-086-24W600 | | | | |
| 100/06-14-086-24W600 | | | | |
| 100/10-32-086-24W600 | | | | |

| | WELL ID | | Top Triassic | | Halfway | | Doig | | Montney | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | KB | BLDN | SS | HLFY | SS | DOIG | SS | MNTN | SS |
| | 100/16-03-086-25W600 | 690.7 | 1219.0 | -528.3 | 1590.0 | -899.3 | 1665.0 | -974.3 | | |
| | 100/06-11-086-25W600 | 654.1 | 1137.8 | -483.7 | 1503.3 | -849.2 | 1574.3 | -920.2 | 1691.6 | -1037.5 |
| • | 100/11-10-086-19W600 | ? | | | 1481.3 | | 1492.2 | | 1578.5 | |
| • | 100/15-06-086-20W600 | 855.6 | | | 1654.0 | -798.4 | 1680.0 | -824.4 | 1765.0 | -909.4 |
| • | 100/06-01-087-19W600 | 761.3 | 1221.5 | -460.2 | 1474.0 | -712.7 | 1490.0 | -728.7 | | |
| | 100/08-01-087-19W600 | 769.0 | 1232.0 | -463.0 | 1472.0 | -703.0 | 1499.5 | -730.5 | | |
| | 100/14-01-087-19W600 | 761.0 | 1227.0 | -466.0 | 1478.5 | -717.5 | 1500.0 | -739.0 | | |
| | 100/15-01-087-19W600 | 757.7 | 1218.0 | -460.3 | 1466.0 | -708.3 | 1483.0 | -725.3 | | |
| | 100/07-02-087-19W600 | 744.6 | 1210.0 | -465.4 | 1458.0 | -713.4 | 1478.0 | -733.4 | | |
| • | 100/11-02-087-19W600 | 746.0 | 1215.0 | -469.0 | 1466.0 | -720.0 | 1486.0 | -740.0 | | |
| • | 100/07-03-087-19W600 | 768.4 | 1239.0 | -470.6 | 1488.0 | -719.6 | 1504.0 | -735.6 | | |
| | 100/08-03-087-19W600 | 771.1 | 1235.5 | -464.4 | 1486.0 | -714.9 | 1510.0 | -738.9 | | |
| | 100/06-05-087-19W600 | 713.6 | 1202.0 | -488.4 | 1452.0 | -738.4 | 1478.0 | -764.4 | | |
| | 100/06-11-087-19W600 | 752.2 | 1242.0 | -489.8 | 1485.0 | -732.8 | 1508.0 | -755.8 | | |
| • | 100/03-12-087-19W600 | 761.8 | 1235.5 | -473.7 | 1486.0 | -724.2 | 1503.0 | -741.2 | 1567.0 | -805.2 |
| ? | 100/10-19-087-19W600 | 762.0 | 1248.0 | -486.0 | 1502.0 | -740.0 | 1525.0 | -763.0 | | |
| | 100/06-24-087-19W600 | 738.0 | 1211.5 | -473.5 | 1455.0 | -717.0 | 1475.3 | -737.3 | | |
| | 100/06-25-087-19W600 | 722.0 | 1187.0 | -465.0 | 1426.0 | -704.0 | 1445.0 | -723.0 | | |
| • | 100/07-26-087-19W600 | 744.2 | 1213.0 | -468.8 | 1453.0 | -708.8 | 1461.0 | -716.8 | | |
| | 100/08-27-087-19W600 | 777.5 | 1250.0 | -472.5 | 1483.0 | -705.5 | 1506.0 | -728.5 | | |
| • | 100/10-27-087-19W600 | 778.2 | 1255.2 | -477.0 | 1482.0 | -703.8 | 1495.9 | -717.7 | ~ 1554.5 | -776.0 |
| | 100/14-27-087-19W600 | 781.8 | 1250.0 | -468.2 | 1490.0 | -708.2 | 1511.0 | -729.2 | | |
| | 100/10-28-087-19W600 | 791.6 | 1267.4 | -475.8 | 1510.9 | -719.3 | 1532.8 | -741.2 | | |
| • | 100/14-35-087-19W600 | 734.2 | 1203.0 | -468.8 | 1437.0 | -702.8 | 1453.0 | -718.8 | | |
| • | 100/06-04-087-20W600 | 782.1 | 1288.7 | -506.6 | 1576.0 | -793.9 | 1587.0 | -804.9 | 1675.5 | -893.4 |
| • | 100/07-05-087-20W600 | 790.3 | 1293.0 | -502.7 | 1577.0 | -786.7 | 1595.2 | -804.9 | ? | |
| • | 100/06-06-087-20W600 | 777.2 | 1290.0 | -512.8 | 1576.0 | -798.8 | 1601.0 | -823.8 | 1681.0 | -903.8 |
| ? | 100/07-07-087-20W600 | 824.5 | 1324.7 | -500.2 | 1612.9 | -788.4 | ? | | ? | |
| | 102/07-07-087-20W600 | 823.3 | 1325.9 | -502.6 | 1614.2 | -790.9 | 1638.6 | -815.3 | | |
| • | 100/10-08-087-20W600 | 785.2 | 1279.6 | -494.4 | 1563.5 | -778.3 | 1572.7 | -787.5 | 1659.9 | -874.7 |
| | 100/11-10-087-20W600 | 779.4 | 1283.2 | -503.8 | 1551.4 | -772.0 | ? 1562.0 | -782.6 | 1642.2 | -862.8 |
| • | 100/06-11-087-20W600 | 778.9 | 1285.0 | -506.1 | 1553.5 | -774.6 | ? 1567.0 | -788.1 | 1651.0 | -872.1 |
| • | 100/11-11-087-20W600 | 785.0 | 1289.0 | -504.0 | 1556.0 | -771.0 | ? 1569.0 | -784.0 | 1656.0 | -871.0 |
| • | 100/06-15-087-20W600 | 818.4 | 1306.0 | -487.6 | 1571.0 | -752.6 | 1586.0 | -767.6 | 1663.0 | -844.6 |
| • | 102/06-15-087-20W600 | 809.8 | 1310.3 | -500.5 | 1574.0 | -764.2 | 1590.0 | -780.2 | | |
| • | 100/06-16-087-20W600 | 813.5 | 1307.6 | -494.1 | 1578.2 | -764.7 | 1594.6 | -781.1 | 1676.9 | -863.4 |
| • | 100/06-20-087-20W600 | 818.4 | 1304.5 | -486.1 | 1584.3 | -765.9 | 1592.8 | -774.4 | 1680.6 | -862.2 |
| • | 100/07-21-087-20W600 | 809.9 | 1294.2 | -484.3 | 1561.1 | -751.2 | ? 1567.2 | -757.3 | 1662.3 | -852.4 |
| • | 102/07-21-087-20W600 | 810.7 | 1296.0 | -485.3 | 1562.5 | -751.8 | 1575.0 | -764.3 | | |
| • | 100/06-22-087-20W600 | 797.4 | 1286.3 | -488.9 | 1556.8 | -759.4 | 1566.6 | -769.2 | ? NDE | |
| | 100/08-25-087-20W600 | 752.2 | 1235.0 | -482.8 | 1487.0 | -734.8 | 1508.0 | -755.8 | | |
| • | 100/14-32-087-20W600 | 801.3 | 1277.0 | -475.7 | 1547.0 | -745.7 | ? | | ? | |
| | 100/15-33-087-20W600 | 800.4 | 1270.0 | -469.6 | 1534.0 | -733.6 | | | | |
| • | 100/10-34-087-20W600 | 758.0 | 1233.2 | -475.2 | 1496.5 | -738.5 | 1506.2 | -748.2 | | |
| • | 100/07-01-087-21W600 | 799.5 | 1297.0 | -497.5 | 1590.5 | -791.0 | 1617.0 | -817.5 | 1699.0 | -899.5 |
| • | 100/14-01-087-21W600 | 802.1 | 1300.0 | -497.9 | 1592.0 | -789.9 | 1616.0 | -813.9 | 1698.0 | -895.9 |
| • | 100/11-02-087-21W600 | 846.6 | 1370.0 | -523.4 | 1662.5 | -815.9 | 1681.0 | -834.4 | 1768.0 | -921.4 |
| • | 100/02-07-087-21W600 | 837.3 | 1375.0 | -537.7 | 1680.5 | -843.2 | 1698.0 | -860.7 | 1787.0 | -949.7 |
| | 100/10-09-087-21W600 | 826.6 | 1367.0 | -540.4 | 1655.7 | -829.1 | 1685.8 | -859.2 | 1764.5 | -937.9 |
| • | 100/07-11-087-21W600 | 814.1 | 1316.7 | -502.6 | 1611.1 | -797.0 | 1628.8 | -814.7 | 1718.4 | -904.3 |
| • | 100/11-12-087-21W600 | 787.3 | 1274.1 | -486.8 | 1563.5 | -776.2 | 1586.7 | -799.4 | 1670.5 | -883.2 |
| • | 100/10-14-087-21W600 | 825.1 | 1307.3 | -482.2 | 1596.5 | -771.4 | 1611.4 | -786.3 | 1704.4 | -879.3 |
| • | 100/07-24-087-21W600 | 832.7 | 1312.8 | -480.1 | 1600.1 | -767.4 | 1624.5 | -791.8 | 1702.5 | -869.8 |
| • | 100/06-26-087-21W600 | 849.5 | 1322.8 | -473.3 | 1604.7 | -755.2 | 1625.1 | -775.6 | 1711.7 | -862.2 |

| WELL ID | Base Triassic |  | 1st Doig Sand |  | Thickness |  | 2nd Doig Sand |  | Thickness |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  | BLLY | SS | 1st Sand | SS | Sand | Silt Eq. | 2nd Sand | SS | Sand | Silt Eq. |
| 100/16-03-086-25W600 |  |  |  |  |  |  |  |  |  |  |
| 100/06-11-086-25W600 | 2006.2 | -1352.1 |  |  |  |  |  |  |  |  |
| 100/11-10-086-19W600 |  |  |  |  |  |  |  |  |  |  |
| 100/15-06-086-20W600 |  |  | 1710.0 | -854.4 | 3.5 | 12.5 |  |  |  |  |
| 100/06-01-087-19W600 |  |  | ? 1499 | -737.7 | 2.0 |  |  |  |  |  |
| 100/08-01-087-19W600 |  |  |  |  |  |  |  |  |  |  |
| 100/14-01-087-19W600 |  |  |  |  |  |  |  |  |  |  |
| 100/15-01-087-19W600 |  |  |  |  |  |  |  |  |  |  |
| 100/07-02-087-19W600 |  |  |  |  |  |  |  |  |  |  |
| 100/11-02-087-19W600 |  |  | ? 1505 | -759.0 | 0.0 |  |  |  |  |  |
| 100/07-03-087-19W600 |  |  | 1533.0 | -764.6 | 0.0 | 5.0 |  |  |  |  |
| 100/08-03-087-19W600 |  |  |  |  |  |  |  |  |  |  |
| 100/06-05-087-19W600 |  |  |  |  |  |  |  |  |  |  |
| 100/06-11-087-19W600 |  |  |  |  |  |  |  |  |  |  |
| 100/03-12-087-19W600 |  |  | 1519.5 | -757.7 | 0.0 | 14.0 |  |  |  |  |
| 100/10-19-087-19W600 |  |  | 1534.0 | -772.0 | 0.0 | 4.0 |  |  |  |  |
| 100/06-24-087-19W600 |  |  |  |  |  |  |  |  |  |  |
| 100/06-25-087-19W600 |  |  |  |  |  |  |  |  |  |  |
| 100/07-26-087-19W600 |  |  | 1482.0 | -737.8 | 0.0 | 8.0 |  |  |  |  |
| 100/08-27-087-19W600 |  |  |  |  |  |  |  |  |  |  |
| 100/10-27-087-19W600 |  |  | 1517.2 | -739.0 | 0.0 | 15.8 |  |  |  |  |
| 100/14-27-087-19W600 |  |  |  |  |  |  |  |  |  |  |
| 100/10-28-087-19W600 |  |  |  |  |  |  |  |  |  |  |
| 100/14-35-087-19W600 |  |  | 1463.0 | -728.8 | TRACE | 12.5 |  |  |  |  |
| 100/06-04-087-20W600 | 1943.0 | -1160.9 | 1612.5 | -830.4 | 2.0 |  | ? NP |  | 0.0 |  |
| 100/07-05-087-20W600 | 1948.9 | -1158.6 | 1617.2 | -826.9 | 0.0 | 3.7 | ? |  |  |  |
| 100/06-06-087-20W600 | 1947.7 | -1170.5 | 1622.0 | -844.8 | 3.5 |  | ? NP |  | 0.0 |  |
| 100/07-07-087-20W600 | 1982.1 | -1157.6 |  |  |  |  |  |  |  |  |
| 102/07-07-087-20W600 |  |  |  |  |  |  |  |  |  |  |
| 100/10-08-087-20W600 | 1924.5 | -1139.3 | 1598.9 | -813.7 | 0.0 | 2.7 | ? NP |  | 0.0 |  |
| 100/11-10-087-20W600 | 1908.7 | -1129.3 | 1587.6 | -808.2 | 0.0 | 2.1 | ? NP |  | 0.0 |  |
| 100/06-11-087-20W600 |  |  | 1595.5 | -816.6 | 1.5 |  | ? NP |  | 0.0 |  |
| 100/11-11-087-20W600 | 1922.0 | -1137.0 | 1601.0 | -816.0 | 7.0 | 9.0 |  |  |  |  |
| 100/06-15-087-20W600 | 1925.0 | -1106.6 | 1606.0 | -787.6 | 0.0 | ? TSE | ? NP |  | 0.0 |  |
| 102/06-15-087-20W600 |  |  | 1609.0 | -799.2 | 0.0 | ? TSE |  |  |  |  |
| 100/06-16-087-20W600 | 1941.6 | -1128.1 | 1608.0 | -794.5 | 0.0 | ? TSE | ? NP |  | 0.0 |  |
| 100/06-20-087-20W600 | 1946.1 | -1127.7 | 1623.3 | -804.9 | 0.0 | ? TSE | ? NP |  | 0.0 |  |
| 100/07-21-087-20W600 | 1931.2 | -1121.3 | 1591.0 | -781.1 | > 14.0 | 18.3 | ? NP |  | 0.0 |  |
| 102/07-21-087-20W600 |  |  | 1591.0 | -780.3 | 16.0 |  |  |  |  |  |
| 100/06-22-087-20W600 | 1919.0 | -1121.6 | 1592.5 | -795.1 | 0.0 | ? TSE |  |  |  |  |
| 100/08-25-087-20W600 |  |  |  |  |  |  |  |  |  |  |
| 100/14-32-087-20W600 | 1910.0 | -1108.7 | 1579.5 | -778.2 | 0.0 | ? TSE |  |  |  |  |
| 100/15-33-087-20W600 |  |  |  |  |  |  |  |  |  |  |
| 100/10-34-087-20W600 |  |  | 1527.6 | -769.6 | 4.3 |  |  |  |  |  |
| 100/07-01-087-21W600 | 1976.0 | -1176.5 | 1638.0 | -838.5 | 3.5 | 6.0 | ? NP |  | 0.0 |  |
| 100/14-01-087-21W600 | 1969.0 | -1166.9 | 1637.0 | -834.9 | 3.5 | 6.5 | ? NP |  | 0.0 |  |
| 100/11-02-087-21W600 | 2036.0 | -1189.4 | 1707.0 | -860.4 | 2.5 | 5.5 | ? NP |  | 0.0 |  |
| 100/02-07-087-21W600 | 2058.0 | -1220.7 |  |  |  |  | 1724.5 | -887.2 | 1.5 | 6.5 |
| 100/10-09-087-21W600 | 2033.6 | -1207.0 |  |  |  |  |  |  |  |  |
| 100/07-11-087-21W600 | 1988.5 | -1174.4 | 1656.8 | -842.7 | 4.9 |  | ? NP |  | 0.0 |  |
| 100/11-12-087-21W600 | 1944.6 | -1157.3 | 1607.4 | -820.1 | 4.9 |  | ? NP |  | 0.0 |  |
| 100/10-14-087-21W600 | 1978.2 | -1153.1 | 1639.1 | -814.0 | 0.0 | 4.9 | ? NP |  | 0.0 |  |
| 100/07-24-087-21W600 | 1977.2 | -1144.5 | 1637.9 | -805.2 | 2.4 | 5.5 | ? NP |  | 0.0 |  |
| 100/06-26-087-21W600 | 1981.2 | -1131.7 | 1647.1 | -797.6 | sand ? | 2.4 | ? NP |  | 0.0 |  |

| WELL ID | DOIG GAS | DOIG OIL | CORE | COMMENTS |
|---|---|---|---|---|
| 100/16-03-086-25W600 | | | | |
| 100/06-11-086-25W600 | | | | |
| 100/11-10-086-19W600 | | | | |
| 100/15-06-086-20W600 | | | | |
| 100/06-01-087-19W600 | | | | |
| 100/08-01-087-19W600 | | | | |
| 100/14-01-087-19W600 | | | | |
| 100/15-01-087-19W600 | | | | |
| 100/07-02-087-19W600 | | | | |
| 100/11-02-087-19W600 | | | | |
| 100/07-03-087-19W600 | | | | |
| 100/08-03-087-19W600 | | | | |
| 100/06-05-087-19W600 | | | | |
| 100/06-11-087-19W600 | | | | |
| 100/03-12-087-19W600 | | | | |
| 100/10-19-087-19W600 | | | CHD | |
| 100/06-24-087-19W600 | | | | |
| 100/06-25-087-19W600 | | | | |
| 100/07-26-087-19W600 | | | | |
| 100/08-27-087-19W600 | | | | |
| 100/10-27-087-19W600 | | | | |
| 100/14-27-087-19W600 | | | | |
| 100/10-28-087-19W600 | | | | |
| 100/14-35-087-19W600 | | | | |
| 100/06-04-087-20W600 | | | | |
| 100/07-05-087-20W600 | | | | |
| 100/06-06-087-20W600 | | | | |
| 100/07-07-087-20W600 | | | | |
| 102/07-07-087-20W600 | | | | |
| 100/10-08-087-20W600 | | | | |
| 100/11-10-087-20W600 | | | | scale problems on gamma log |
| 100/06-11-087-20W600 | | | | |
| 100/11-11-087-20W600 | | ? | | |
| 100/06-15-087-20W600 | | | | |
| 102/06-15-087-20W600 | | | | |
| 100/06-16-087-20W600 | | | | |
| 100/06-20-087-20W600 | | | | |
| 100/07-21-087-20W600 | | X | | |
| 102/07-21-087-20W600 | | | | |
| 100/06-22-087-20W600 | | | HD | |
| 100/08-25-087-20W600 | | | | |
| 100/14-32-087-20W600 | | | | |
| 100/15-33-087-20W600 | | | | |
| 100/10-34-087-20W600 | | | | |
| 100/07-01-087-21W600 | | | | Questionable 1st sand correlation |
| 100/14-01-087-21W600 | | | | Questionable 1st sand correlation |
| 100/11-02-087-21W600 | | | | Questionable 1st sand correlation |
| 100/02-07-087-21W600 | | | | |
| 100/10-09-087-21W600 | | | | |
| 100/07-11-087-21W600 | | | | Questionable 1st sand correlation |
| 100/11-12-087-21W600 | | | | Questionable 1st sand correlation |
| 100/10-14-087-21W600 | | | | poor quality log, Questionable 1st sand correlation |
| 100/07-24-087-21W600 | | | | Questionable 1st sand correlation |
| 100/06-26-087-21W600 | | | | Questionable 1st sand correlation |

|  | WELL ID |  | Top Triassic |  | Halfway |  | Doig |  | Montney |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  | KB | BLDN | SS | HLFY | SS | DOIG | SS | MNTN | SS |
| • | 102/06-26-087-21W600 | 850.7 | 1324.0 | -473.3 | 1605.5 | -754.8 | 1626.5 | -775.8 |  |  |
| • | 100/07-28-087-21W600 | 818.7 | 1326.5 | -507.8 | 1610.0 | -791.3 | 1628.0 | -809.3 | 1715.0 | -896.3 |
|  | 100/06-31-087-21W600 | 781.5 | 1271.3 | -489.8 | 1539.5 | -758.0 | 1571.5 | -790.0 |  |  |
| • | 100/10-32-087-21W600 | 820.8 | 1302.1 | -481.3 | 1591.0 | -770.2 | 1609.3 | -788.5 | 1694.0 | -873.2 |
| • | 100/12-01-087-22W600 | 766.9 | 1320.5 | -553.6 | 1627.0 | -860.1 | 1647.0 | -880.1 | 1739.0 | -972.1 |
| • | 100/06-09-087-22W600 | 879.0 | 1405.1 | -526.1 | 1719.0 | -840.0 | 1750.1 | -871.1 | ? |  |
| • | 100/16-10-087-22W600 | 808.7 | 1356.0 | -547.3 | 1657.0 | -848.3 | 1686.5 | -877.8 | 1782.0 | -973.3 |
|  | 100/07-13-087-22W600 | 842.5 | 1373.7 | -531.2 | 1669.4 | -826.9 | 1688.6 | -846.1 |  |  |
| • | 100/10-13-087-22W600 | 839.4 | 1368.9 | -529.5 | 1653.2 | -813.8 | 1680.6 | -841.2 | 1772.3 | -932.9 |
| • | 100/06-14-087-22W600 | 869.9 | 1414.0 | -544.1 | 1709.0 | -839.1 | 1738.5 | -868.6 | 1833.0 | -963.1 |
| • | 100/07-20-087-22W600 | 853.4 | 1376.2 | -522.8 | 1681.8 | -828.4 | 1712.9 | -859.5 | 1813.5 | -960.1 |
| • | 100/10-28-087-22W600 | 814.4 | 1326.8 | -512.4 | 1617.8 | -803.4 | 1646.1 | -831.7 | 1741.0 | -926.6 |
|  | 100/06-01-087-23W600 | 766.6 | 1347.8 | -581.2 | 1664.2 | -897.6 | 1706.6 | -940.0 |  |  |
|  | 100/16-07-087-23W600 | 890.6 | 1461.2 | -570.6 | 1792.2 | -901.6 | 1834.9 | -944.3 |  |  |
| • | 100/03-17-087-23W600 | 911.7 | 1460.0 | -548.3 | 1798.2 | -886.5 | 1833.6 | -921.9 | ? |  |
|  | 100/06-26-087-23W600 | 871.4 | 1425.0 | -553.6 | 1724.5 | -853.1 |  |  |  |  |
|  | 100/06-27-087-23W600 | 777.2 | 1348.7 | -571.5 | 1661.2 | -884.0 | 1710.5 | -933.3 |  |  |
|  | 100/16-31-087-23W600 | 850.4 | 1392.0 | -541.6 | 1690.0 | -839.6 | 1740.0 | -889.6 |  |  |
|  | 100/07-19-087-24W600 | 839.7 | 1466.0 | -626.3 | 1795.9 | -956.2 |  |  |  |  |
|  | 100/06-28-087-24W600 | 751.9 | 1405.1 | -653.2 | 1732.8 | -980.9 | 1778.5 | -1026.6 |  |  |
|  | 100/11-31-087-24W600 | 775.1 | 1325.3 | -550.2 | 1650.5 | -875.4 | 1685.2 | -910.1 |  |  |
|  | 100/10-02-087-25W600 | 730.9 | 1177.4 | -446.5 | 1536.2 | -805.3 | 1601.4 | -870.5 | 1705.4 | -974.5 |
|  | 100/16-10-087-25W600 | 751.3 | 1263.7 | -512.4 | 1617.9 | -866.6 | 1683.1 | -931.8 |  |  |
|  | 100/08-11-087-25W600 | 741.3 | 1134.5 | -393.2 | 1472.2 | -730.9 | 1533.1 | -791.8 | 1652.0 | -910.7 |
|  | 100/09-11-087-25W600 | 736.0 | 1131.5 | -395.5 | 1474.0 | -738.0 | 1539.5 | -803.5 | 1642.0 | -906.0 |
|  | 100/14-11-087-25W600 | 749.2 | 1191.8 | -442.6 | 1540.2 | -791.0 | 1591.7 | -842.5 |  |  |
|  | 100/06-22-087-25W600 | 700.7 | 1209.8 | -509.1 | 1545.3 | -844.6 | 1603.2 | -902.5 |  |  |
|  | 100/07-22-087-25W600 | 686.1 | 1180.0 | -493.9 | 1514.0 | -827.9 | 1571.0 | -884.9 |  |  |
|  | 102/06-23-087-25W600 | 671.8 | 1129.9 | -458.1 | 1465.8 | -794.0 | 1529.2 | -857.4 |  |  |
|  | 100/10-27-087-25W600 | 642.7 | 1123.5 | -480.8 | 1467.5 | -824.8 | 1530.0 | -887.3 | 1634.0 | -991.3 |
| • | 100/06-10-088-19W600 | 744.0 | 1200.9 | -456.9 | 1426.4 | -682.4 | 1444.1 | -700.1 | NDE |  |
|  | 100/01-12-088-19W600 | 730.3 | 1181.1 | -450.8 | 1407.0 | -676.7 | 1426.5 | -696.2 |  |  |
| • | 100/11-16-088-19W600 | 775.4 | 1224.0 | -448.6 | 1453.5 | -678.1 | 1470.0 | -694.6 |  |  |
| • | 100/06-18-088-19W600 | 775.1 | 1229.0 | -453.9 | 1472.1 | -697.0 | 1490.7 | -715.6 | 1555.6 | -780.5 |
| • | 100/07-19-088-19W600 | 745.2 | 1202.0 | -456.8 | 1436.0 | -690.8 | 1449.5 | -704.3 | NDE |  |
| • | 100/06-21-088-19W600 | 763.0 | 1215.0 | -452.0 | 1438.0 | -675.0 | 1455.0 | -692.0 |  |  |
|  | 100/11-26-088-19W600 | 713.2 | 1157.5 | -444.3 | 1375.0 | -661.8 | 1390.0 | -676.8 |  |  |
| • | 100/05-03-088-20W600 | 775.0 | 1246.0 | -471.0 | 1503.0 | -728.0 | 1524.0 | -749.0 |  |  |
|  | 100/04-07-088-20W600 | 742.8 | 1205.8 | -463.0 | 1478.3 | -735.5 | 1502.7 | -759.9 |  |  |
|  | 100/11-08-088-20W600 | 798.3 | 1268.0 | -469.7 | 1524.0 | -725.7 | 1552.3 | -754.0 | 1625.8 | -827.5 |
| ? | 100/06-16-088-20W600 | 793.1 | 1254.9 | -461.8 | 1509.3 | -716.2 | 1527.6 | -734.5 |  |  |
|  | 100/07-24-088-20W600 | 769.0 | 1219.8 | -450.8 | 1460.0 | -691.0 | 1478.3 | -709.3 |  |  |
| • | 100/10-29-088-20W600 | 755.0 | 1208.0 | -453.0 | 1463.0 | -708.0 | 1483.0 | -728.0 | 1552.0 | -797.0 |
| • | 100/11-33-088-20W600 | 709.5 | 1151.0 | -441.5 | 1399.0 | -689.5 | 1417.0 | -707.5 |  |  |
| • | 100/09-34-088-20W600 | 714.4 | 1155.0 | -440.6 | 1386.0 | -671.6 | 1399.0 | -684.6 |  |  |
| • | 100/06-02-088-21W600 | 798.9 | 1263.0 | -464.1 | 1540.0 | -741.1 | 1568.0 | -769.1 | 1643.0 | -844.1 |
|  | 100/07-08-088-21W600 | 832.1 | 1325.9 | -493.8 | 1609.3 | -777.2 |  |  |  |  |
| • | 100/06-14-088-21W600 | 716.9 | 1187.8 | -470.9 | 1447.1 | -730.2 | 1482.5 | -765.6 | 1558.4 | -841.5 |
| • | 100/11-10-088-22W600 | 808.9 | 1316.7 | -507.8 | 1592.5 | -783.6 | 1618.4 | -809.5 | 1705.3 | -896.4 |
|  | 100/10-14-088-22W600 | 784.3 | 1298.1 | -513.8 | 1576.7 | -792.4 |  |  |  |  |
| • | 100/11-15-088-22W600 | 786.7 | 1265.0 | -478.3 | 1555.0 | -768.3 | 1579.0 | -792.3 |  |  |
| • | 100/10-16-088-22W600 | 798.0 | 1303.9 | -505.9 | 1584.3 | -786.3 | 1640.7 | -842.7 |  |  |
|  | 100/10-17-088-22W600 | 785.2 | 1303.0 | -517.8 | 1587.0 | -801.8 | 1610.0 | -824.8 |  |  |
|  | 100/10-20-088-22W600 | 741.0 | 1252.7 | -511.7 | 1535.9 | -794.9 |  |  |  |  |

| WELL ID | Base Triassic | | 1st Doig Sand | | Thickness | | 2nd Doig Sand | | Thickness | |
|---|---|---|---|---|---|---|---|---|---|---|
| | BLLY | SS | 1st Sand | SS | Sand | Silt Eq. | 2nd Sand | SS | Sand | Silt Eq. |
| 102/06-26-087-21W600 | | | NDE | | | | | | | |
| 100/07-28-087-21W600 | 1980.0 | -1161.3 | 1634.0 | -815.3 | 1.0 | | 1650.0 | -831.3 | 0.0 | 2.5 |
| 100/06-31-087-21W600 | | | | | | | | | | |
| 100/10-32-087-21W600 | 1960.8 | -1140.0 | 1628.8 | -808.0 | 0.0 | 2.4 | ? NP | | 0.0 | |
| 100/12-01-087-22W600 | 2018.0 | -1251.1 | ? NP | | 0.0 | | 1675.0 | -908.1 | 1.5 | |
| 100/06-09-087-22W600 | 2133.6 | -1254.6 | | | | | 1779.3 | -900.3 | 0.0 | 4.9 |
| 100/16-10-087-22W600 | 2050.0 | -1241.3 | ? NP | | 0.0 | | 1712.0 | -903.3 | 2.5 | 17.0 |
| 100/07-13-087-22W600 | | | | | | | | | | |
| 100/10-13-087-22W600 | 2051.3 | -1211.9 | ? NP | | 0.0 | | 1705.3 | -865.9 | 0.0 | 6.1 |
| 100/06-14-087-22W600 | 2107.0 | -1237.1 | ? 1776.5 | -906.6 | 0.0 | 3.0 | 1764.0 | -894.1 | 0.0 | 5.0 |
| 100/07-20-087-22W600 | 2080.6 | -1227.2 | ? NP | | 0.0 | | 1739.7 | -886.3 | 0.0 | 2.4 |
| 100/10-28-087-22W600 | 2008.0 | -1193.6 | ? NP | | 0.0 | | 1670.8 | -856.4 | 0.0 | 4.3 |
| 100/06-01-087-23W600 | | | | | | | | | | |
| 100/16-07-087-23W600 | | | | | | | | | | |
| 100/03-17-087-23W600 | 2234.5 | -1322.8 | ? | | | | ? | | | |
| 100/06-26-087-23W600 | | | | | | | | | | |
| 100/06-27-087-23W600 | | | | | | | | | | |
| 100/16-31-087-23W600 | | | | | | | | | | |
| 100/07-19-087-24W600 | | | | | | | | | | |
| 100/06-28-087-24W600 | | | | | | | | | | |
| 100/11-31-087-24W600 | | | | | | | | | | |
| 100/10-02-087-25W600 | 2027.5 | -1296.6 | | | | | | | | |
| 100/16-10-087-25W600 | | | | | | | | | | |
| 100/08-11-087-25W600 | 1987.3 | -1246.0 | | | | | | | | |
| 100/09-11-087-25W600 | 1974.0 | -1238.0 | | | | | | | | |
| 100/14-11-087-25W600 | | | | | | | | | | |
| 100/06-22-087-25W600 | | | | | | | | | | |
| 100/07-22-087-25W600 | | | | | | | | | | |
| 102/06-23-087-25W600 | | | | | | | | | | |
| 100/10-27-087-25W600 | 2008.0 | -1365.3 | | | | | | | | |
| 100/06-10-088-19W600 | | | ? 1453.8 | -709.8 | 0.0 | 19.5 | | | | |
| 100/01-12-088-19W600 | | | | | | | | | | |
| 100/11-16-088-19W600 | | | ? 1482.0 | -706.6 | 0.0 | 17.0 | | | | |
| 100/06-18-088-19W600 | | | ? 1506.2 | -731.1 | 0.0 | 15.2 | ? NP | | 0.0 | |
| 100/07-19-088-19W600 | | | 1466.0 | -720.8 | 0.0 | 13.0 | | | | |
| 100/06-21-088-19W600 | | | 1466.0 | -703.0 | 0.0 | 17.0 | | | | |
| 100/11-26-088-19W600 | | | | | | | | | | |
| 100/05-03-088-20W600 | | | 1533.0 | -758.0 | 1.5 | | | | | |
| 100/04-07-088-20W600 | | | | | | | | | | |
| 100/11-08-088-20W600 | 1895.9 | -1097.6 | | | | | | | | |
| 100/06-16-088-20W600 | | | ? | | | | | | | |
| 100/07-24-088-20W600 | | | | | | | | | | |
| 100/10-29-088-20W600 | 1822.5 | -1067.5 | 1512.0 | -757.0 | 0.0 | 18.0 | ? NP | | 0.0 | |
| 100/11-33-088-20W600 | | | | | | | | | | |
| 100/09-34-088-20W600 | | | 1408.0 | -693.6 | > 40.0 | | | | | |
| 100/06-02-088-21W600 | 1909.0 | -1110.1 | 1575.0 | -776.1 | 1.5 | | ? NP | | 0.0 | |
| 100/07-08-088-21W600 | | | | | | | | | | |
| 100/06-14-088-21W600 | 1830.3 | -1113.4 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/11-10-088-22W600 | 1972.1 | -1163.2 | 1636.7 | -827.8 | 15.0 | | ? NP | | 0.0 | |
| 100/10-14-088-22W600 | | | | | | | | | | |
| 100/11-15-088-22W600 | | | | | | | 1596.0 | -809.3 | 0.0 | 3.0 |
| 100/10-16-088-22W600 | | | NDE | | | | NDE | | | |
| 100/10-17-088-22W600 | | | | | | | | | | |
| 100/10-20-088-22W600 | | | | | | | | | | |

| WELL ID | DOIG | DOIG | CORE | COMMENTS |
|---|---|---|---|---|
| | GAS | OIL | | |
| 102/06-26-087-21W600 | | | H | Questionable 1st sand correlation |
| 100/07-28-087-21W600 | | | | |
| 100/06-31-087-21W600 | | | | |
| 100/10-32-087-21W600 | | | | Questionable 1st sand correlation |
| 100/12-01-087-22W600 | | | | |
| 100/06-09-087-22W600 | | | | poor quality log |
| 100/16-10-087-22W600 | | | | |
| 100/07-13-087-22W600 | | | | |
| 100/10-13-087-22W600 | | | | |
| 100/06-14-087-22W600 | | | | |
| 100/07-20-087-22W600 | | | | poor quality log |
| 100/10-28-087-22W600 | | | | |
| 100/06-01-087-23W600 | | | | |
| 100/16-07-087-23W600 | | | | |
| 100/03-17-087-23W600 | | | | |
| 100/06-26-087-23W600 | | | | |
| 100/06-27-087-23W600 | | | | |
| 100/16-31-087-23W600 | | | | |
| 100/07-19-087-24W600 | | | | |
| 100/06-28-087-24W600 | | | | |
| 100/11-31-087-24W600 | | | | |
| 100/10-02-087-25W600 | | | | |
| 100/16-10-087-25W600 | | | | |
| 100/08-11-087-25W600 | | | | |
| 100/09-11-087-25W600 | | | | |
| 100/14-11-087-25W600 | | | | |
| 100/06-22-087-25W600 | | | | |
| 100/07-22-087-25W600 | | | | |
| 102/06-23-087-25W600 | | | | |
| 100/10-27-087-25W600 | | | | |
| 100/06-10-088-19W600 | | | | |
| 100/01-12-088-19W600 | | | | |
| 100/11-16-088-19W600 | | | | |
| 100/06-18-088-19W600 | | | | |
| 100/07-19-088-19W600 | | | | |
| 100/06-21-088-19W600 | | | CH | |
| 100/11-26-088-19W600 | | | | |
| 100/05-03-088-20W600 | | | | TSE @ 1535 ? |
| 100/04-07-088-20W600 | | | | |
| 100/11-08-088-20W600 | | | | |
| 100/06-16-088-20W600 | | | | 16-18-88-20/w6?: poor quality log |
| 100/07-24-088-20W600 | | | H | e-log |
| 100/10-29-088-20W600 | | | | |
| 100/11-33-088-20W600 | | | | |
| 100/09-34-088-20W600 | | X | D | Could Doig 1st sand at this locale be HFWY inlet? |
| 100/06-02-088-21W600 | | | | Questionable 1st sand correlation |
| 100/07-08-088-21W600 | | | | |
| 100/06-14-088-21W600 | | | | |
| 100/11-10-088-22W600 | | | | |
| 100/10-14-088-22W600 | | | | |
| 100/11-15-088-22W600 | | | | |
| 100/10-16-088-22W600 | | | | |
| 100/10-17-088-22W600 | | | | |
| 100/10-20-088-22W600 | | | | |

|  | WELL ID |  | Top Triassic |  | Halfway |  | Doig |  | Montney |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  | KB | BLDN | SS | HLFY | SS | DOIG | SS | MNTN | SS |
|  | 100/06-22-088-22W600 | 726.3 | 1226.8 | -500.5 | 1496.6 | -770.3 | 1521.6 | -795.3 |  |  |
|  | 100/10-27-088-22W600 | 795.2 | 1310.6 | -515.4 | 1581.0 | -785.8 |  |  |  |  |
| ? | 100/06-28-088-22W600 | 729.4 | 1223.8 | -494.4 | 1519.0 | -789.6 | 1542.0 | -812.6 |  |  |
| • | 100/02-33-088-22W600 | 783.3 | 1267.0 | -483.7 | 1532.0 | -748.7 | 1561.0 | -777.7 | 1652.0 | -868.7 |
|  | 100/11-07-088-23W600 | 872.0 | 1424.0 | -552.0 | 1726.0 | -854.0 | 1771.0 | -899.0 |  |  |
| • | 100/13-07-088-23W600 | 880.6 | 1435.6 | -555.0 | 1743.4 | -862.8 | 1779.9 | -899.3 | 1875.0 | -994.4 |
| • | 100/10-12-088-23W600 | 826.3 | 1339.3 | -513.0 | 1636.1 | -809.8 | 1665.3 | -839.0 | ? |  |
|  | 100/07-22-088-23W600 | 866.5 | 1382.6 | -516.1 | 1666.6 | -800.1 | 1699.0 | -832.5 |  |  |
|  | 100/10-27-088-23W600 | 826.0 | 1337.0 | -511.0 | 1625.0 | -799.0 | 1655.0 | -829.0 |  |  |
|  | 100/06-03-088-24W600 | 759.6 | 1366.4 | -606.8 | 1682.5 | -922.9 | 1726.4 | -966.8 |  |  |
| • | 100/03-06-088-24W600 | 732.2 | 1277.0 | -544.8 | 1590.3 | -858.1 | 1645.7 | -913.5 | 1745.0 | -1012.8 |
| • | 100/11-19-088-24W600 | 837.9 | 1366.1 | -528.2 | 1683.7 | -845.8 | 1735.5 | -897.6 | 1831.8 | -993.9 |
|  | 100/10-25-088-24W600 | 859.8 | 1432.6 | -572.8 | 1735.5 | -875.7 | 1767.8 | -908.0 | 1863.9 | -1004.1 |
|  | 100/08-01-088-25W600 | 800.7 | 1362.5 | -561.8 | 1651.7 | -851.0 | 1726.4 | -925.7 | 1841.6 | -1040.9 |
|  | 100/06-02-088-25W600 | 806.8 | 1425.5 | -618.7 | 1725.0 | -918.2 | 1804.0 | -997.2 |  |  |
|  | 100/10-04-088-25W600 | 692.8 | 1177.1 | -484.3 | 1513.0 | -820.2 | 1570.0 | -877.2 |  |  |
|  | 100/06-10-088-25W600 | 712.3 | 1354.0 | -641.7 | 1690.5 | -978.2 | 1748.0 | -1035.7 |  |  |
|  | 100/10-11-088-25W600 | 918.7 | 1522.0 | -603.3 | 1850.0 | -931.3 | 1905.0 | -986.3 |  |  |
|  | 100/10-12-088-25W600 | 758.3 | 1313.7 | -555.4 | 1633.7 | -875.4 | 1685.5 | -927.2 | 1783.1 | -1024.8 |
|  | 100/10-14-088-25W600 | 861.4 | 1452.0 | -590.6 | 1780.0 | -918.6 | 1830.0 | -968.6 |  |  |
| • | 100/14-20-088-25W600 | 749.8 | 1217.0 | -467.2 | 1545.0 | -795.2 | 1599.3 | -849.5 | 1692.0 | -942.2 |
|  | 100/06-25-088-25W600 | 722.4 | 1209.4 | -487.0 | 1520.0 | -797.6 | 1569.1 | -846.7 | 1667.0 | -944.6 |
|  | 102/06-25-088-25W600 | 724.0 | 1212.5 | -488.5 | 1520.0 | -796.0 | 1569.1 | -845.1 | 1667.0 | -943.0 |
|  | 100/14-25-088-25W600 | 727.6 | 1207.0 | -479.4 | 1481.6 | -754.0 | 1554.5 | -826.9 | 1659.3 | -931.7 |
| • | 100/12-29-088-25W600 | 764.5 | 1222.3 | -457.8 | 1546.0 | -781.5 | 1599.0 | -834.5 | 1691.5 | -927.0 |
|  |  |  |  |  |  |  |  |  |  |  |
|  | 100/06-22-088-21W600 | ? |  |  | 1541.0 | ####### | 1565.0 | ####### | 1641.0 | ####### |

| WELL ID | Base Triassic | | 1st Doig Sand | | Thickness | | 2nd Doig Sand | | Thickness | |
|---|---|---|---|---|---|---|---|---|---|---|
| | BLLY | SS | 1st Sand | SS | Sand | Silt Eq. | 2nd Sand | SS | Sand | Silt Eq. |
| 100/06-22-088-22W600 | | | | | | | | | | |
| 100/10-27-088-22W600 | | | | | | | | | | |
| 100/06-28-088-22W600 | | | NDE | | | | NDE | | | |
| 100/02-33-088-22W600 | 1925.5 | -1142.2 | 1602.0 | -818.7 | ? 7.0 | 7.0 | 1585.0 | -801.7 | ? 12 | 12.0 |
| 100/11-07-088-23W600 | | | | | | | | | | |
| 100/13-07-088-23W600 | 2159.8 | -1279.2 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/10-12-088-23W600 | 2031.2 | -1204.9 | ? | | | | ? | | | |
| 100/07-22-088-23W600 | | | | | | | | | | |
| 100/10-27-088-23W600 | | | | | | | | | | |
| 100/06-03-088-24W600 | | | | | | | | | | |
| 100/03-06-088-24W600 | 2045.0 | -1312.8 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/11-19-088-24W600 | 2136.6 | -1298.7 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/10-25-088-24W600 | 2151.9 | -1292.1 | | | | | | | | |
| 100/08-01-088-25W600 | 2142.7 | -1342.0 | | | | | | | | |
| 100/06-02-088-25W600 | | | | | | | | | | |
| 100/10-04-088-25W600 | | | | | | | | | | |
| 100/06-10-088-25W600 | | | | | | | | | | |
| 100/10-11-088-25W600 | | | | | | | | | | |
| 100/10-12-088-25W600 | 2084.8 | -1326.5 | | | | | | | | |
| 100/10-14-088-25W600 | | | | | | | | | | |
| 100/14-20-088-25W600 | 1992.0 | -1242.2 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| 100/06-25-088-25W600 | 1963.8 | -1241.4 | | | | | | | | |
| 102/06-25-088-25W600 | 1963.8 | -1239.8 | | | | | | | | |
| 100/14-25-088-25W600 | 1947.7 | -1220.1 | | | | | | | | |
| 100/12-29-088-25W600 | 1992.0 | -1227.5 | ? NP | | 0.0 | | ? NP | | 0.0 | |
| | | | | | | | | | | |
| 100/06-22-088-21W600 | | | | | | | | | | |

| WELL ID | DOIG GAS | DOIG OIL | CORE | COMMENTS |
|---|---|---|---|---|
| 100/06-22-088-22W600 | | | | |
| 100/10-27-088-22W600 | | | | |
| 100/06-28-088-22W600 | | | | 10-28-88-22/w6 ? |
| 100/02-33-088-22W600 | | | | |
| 100/11-07-088-23W600 | | | | |
| 100/13-07-088-23W600 | | | | |
| 100/10-12-088-23W600 | | | | |
| 100/07-22-088-23W600 | | | • | |
| 100/10-27-088-23W600 | | | | |
| 100/06-03-088-24W600 | | | | |
| 100/03-06-088-24W600 | | | | |
| 100/11-19-088-24W600 | | | | |
| 100/10-25-088-24W600 | | | | |
| 100/08-01-088-25W600 | | | | |
| 100/06-02-088-25W600 | | | | |
| 100/10-04-088-25W600 | | | | |
| 100/06-10-088-25W600 | | | | |
| 100/10-11-088-25W600 | | | | |
| 100/10-12-088-25W600 | | | | |
| 100/10-14-088-25W600 | | | | |
| 100/14-20-088-25W600 | | | | |
| 100/06-25-088-25W600 | | | | |
| 102/06-25-088-25W600 | | | | |
| 100/14-25-088-25W600 | | | | |
| 100/12-29-088-25W600 | | | | |
| | | | | |
| 100/06-22-088-21W600 | | | | |

# APPENDIX E2: DOIG STUDY

# STRATIGRAPHIC TOPS FILES (NTS AREA)

| | WELL ID | | Top Triassic | | Halfway | | Doig | | Montney | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | KB | BLDN | SS | HLFY | SS | DOIG | SS | MNTN | SS |
| | d-28-I/94-A-10 | 739.7 | 1140.0 | -400.3 | 1320.0 | -580.3 | 1327.0 | -587.3 | | |
| | d-33-I/94-A-10 | 716.6 | 1115.0 | -398.4 | 1278.3 | -561.7 | 1288.1 | -571.5 | | |
| | d-57-I/94-A-10 | 757.7 | 1142.4 | -384.7 | 1317.7 | -560.0 | 1350.3 | -592.6 | | |
| | a-63-I/94-A-10 | 722.5 | 1116.0 | -393.5 | 1283.0 | -560.5 | 1288.0 | -565.5 | | |
| | c-07-I/94-A-10 | 718.1 | 1106.0 | -387.9 | 1252.0 | -533.9 | 1255.0 | -536.9 | | |
| | d-74-I/94-A-10 | 731.1 | 1108.0 | -376.9 | 1265.0 | -533.9 | 1295.5 | -564.4 | | |
| | a-83-I/94-A-10 | 725.7 | 1105.5 | -379.8 | 1261.5 | -535.8 | 1272.5 | -546.8 | | |
| | d-95-I/94-A-10 | 738.0 | 1112.0 | -374.0 | 1285.0 | -547.0 | 1291.0 | -553.0 | | |
| • | d-97-I/94-A-10 | 747.7 | 1123.0 | -375.3 | 1301.5 | -553.8 | 1303.0 | -555.3 | 1347.5 | -599.8 |
| • | c-51-J/94-A-10 | 720.3 | 1135.0 | -414.7 | 1321.5 | -601.2 | 1332.5 | -612.2 | | |
| • | a-67-J/94-A-10 | 706.5 | 1113.0 | -406.5 | 1298.0 | -591.5 | 1304.5 | -598.0 | | |
| • | a-29-K/94-A-10 | 724.1 | 1155.0 | -430.9 | 1364.0 | -639.9 | 1377.0 | -652.9 | | |
| • | d-51-K/94-A-10 | 686.6 | 1101.0 | -414.4 | 1293.0 | -606.4 | 1305.0 | -618.4 | | |
| | c-54-K/94-A-10 | 578.2 | 997.9 | -419.7 | 1194.8 | -616.6 | 1208.2 | -630.0 | | |
| | a-87-K/94-A-10 | 665.1 | 1082.0 | -416.9 | 1275.3 | -610.2 | | | | |
| • | d-87-K/94-A10 | 663.3 | 1082.0 | -418.7 | 1273.7 | -610.4 | 1283.0 | -619.7 | 1339.0 | -675.7 |
| • | b-56-L/94-A-10 | 699.2 | 1137.8 | -438.6 | 1347.2 | -648.0 | 1365.2 | -666.0 | | |
| • | b-24-I/94-A-11 | 726.5 | 1166.0 | -439.5 | 1397.0 | -670.5 | 1415.0 | -688.5 | | |
| • | d-36-I/94-A-11 | 690.6 | 1129.0 | -438.4 | 1359.0 | -668.4 | 1377.0 | -686.4 | NDE | |
| • | b-44-I/94-A-11 | 711.3 | 1150.0 | -438.7 | 1379.0 | -667.7 | 1394.5 | -683.2 | 1454.0 | -742.7 |
| • | d-45-I/94-A-11 | 681.5 | 1153.0 | -471.5 | 1379.0 | -697.5 | 1394.0 | -712.5 | | |
| • | d-46-I/94-A-11 | 676.0 | 1112.5 | -436.5 | 1335.6 | -659.6 | 1348.7 | -672.7 | | |
| • | d-49-I/94-A-11 | 680.0 | 1116.8 | -436.8 | 1354.8 | -674.8 | 1372.2 | -692.2 | 1434.4 | -754.4 |
| d | b-56-I/94-A-11 | 671.0 | 1160.0 | -489.0 | 1396.0 | -725.0 | 1417.0 | -746.0 | | |
| • | c-57-I/94-A-11 | 682.3 | 1110.0 | -427.7 | 1331.0 | -648.7 | 1345.0 | -662.7 | | |
| • | 02/d-57-I/94-A-11 | 678.2 | 1109.5 | -431.3 | 1326.5 | -648.3 | 1338.1 | -659.9 | | |
| • | d-58-I/94-A-11 | 688.5 | 1119.5 | -431.0 | 1339.6 | -651.1 | 1353.3 | -664.8 | | |
| | d-59-I/94-A-11 | 723.3 | 1158.2 | -434.9 | 1386.2 | -662.9 | 1403.9 | -680.6 | | |
| • | a-67-I/94-A-11 | 683.4 | 1111.3 | -427.9 | 1332.6 | -649.2 | 1344.7 | -661.3 | | |
| • | b-67-I/94-A-11 | 694.9 | 1125.0 | -430.1 | 1343.0 | -648.1 | 1355.0 | -660.1 | | |
| • | a-68-I/94-A-11 | 706.2 | 1137.0 | -430.8 | 1362.0 | -655.8 | 1375.5 | -669.3 | | |
| • | d-68-I/94-A-11 | 714.5 | 1143.0 | -428.5 | 1362.2 | -647.7 | 1375.3 | -660.8 | | |
| • | d-69-I/94-A-11 | 749.0 | 1182.0 | -433.0 | 1411.0 | -662.0 | 1427.0 | -678.0 | | |
| • | d-76-I/94-A-11 | 694.8 | 1122.0 | -427.2 | 1344.0 | -649.2 | 1360.0 | -665.2 | 1422.0 | -727.2 |
| • | b-77-I/94-A-11 | 700.8 | 1127.0 | -426.2 | 1349.0 | -648.2 | 1357.0 | -656.2 | NDE | |
| • | d-79-I/94-A-11 | 711.3 | 1143.5 | -432.2 | 1373.0 | -661.7 | 1387.0 | -675.7 | | |
| • | d-85-I/94-A-11 | 723.8 | | | 1369.5 | -645.7 | 1379.0 | -655.2 | | |
| • | d-86-I/94-A-11 | 734.9 | 1159.0 | -424.1 | 1374.0 | -639.1 | 1383.5 | -648.6 | | |
| • | d-93-I/94-A-11 | 674.7 | 1117.5 | -442.8 | 1330.0 | -655.3 | 1341.0 | -666.3 | | |
| • | 02/d-96-I/94-A-11 | 735.1 | | | 1369.0 | -633.9 | 1376.0 | -640.9 | | |
| • | 03/d-96-I/94-A-11 | 735.4 | 1158.0 | -422.6 | 1371.0 | -635.6 | 1378.0 | -642.6 | | |
| • | d-98-I/94-A-11 | 708.4 | 1133.9 | -425.5 | 1357.6 | -649.2 | 1374.6 | -666.2 | 1430.7 | -722.3 |
| • | d-33-I/94-A-11 | 685.8 | 1130.2 | -444.4 | 1377.7 | -691.9 | 1396.0 | -710.2 | NDE | |
| • | d-52-J/94-A-11 | 759.4 | 1187.0 | -427.6 | 1425.0 | -665.6 | 1448.0 | -688.6 | 1509.0 | -749.6 |
| | d-55-J/94-A-11 | 695.6 | 1147.3 | -451.7 | 1395.4 | -699.8 | 1411.2 | -715.6 | | |
| • | c-56-J/94-A-11 | 758.3 | 1214.3 | -456.0 | 1466.7 | -708.4 | 1480.1 | -721.8 | | |
| | c-79-J/94-A-11 | 776.9 | 1228.3 | -451.4 | 1480.7 | -703.8 | | | | |
| • | d-83-J/94-A-11 | 775.4 | 1194.2 | -418.8 | 1433.5 | -658.1 | 1452.4 | -677.0 | | |
| • | b-26-K/94-A-11 | 769.5 | 1265.0 | -495.5 | 1536.5 | -767.0 | 1561.0 | -791.5 | 1637.0 | -867.5 |
| • | d-31-K/94-A-11 | 760.5 | 1219.0 | -458.5 | 1485.0 | -724.5 | 1503.0 | -742.5 | 1576.0 | -815.5 |
| • | d-33-K/94-A-11 | 694.0 | 1140.7 | -446.7 | 1406.0 | -712.0 | 1421.3 | -727.3 | | |
| | d-38-K/94-A-11 | 797.1 | 1272.2 | -475.1 | 1542.3 | -745.2 | | | | |

| WELL ID | Base Triassic | | 1st Doig Sand | | Thickness | | 2nd Doig Sand | | Thickness | |
|---|---|---|---|---|---|---|---|---|---|---|
| | BLLY | SS | 1st Sand | SS | Sand | Silt Eq. | 2nd Sand | SS | Sand | Silt Eq. |
| d-28-I/94-A-10 | | | | | | | | | | |
| d-33-I/94-A-10 | | | | | | | | | | |
| d-57-I/94-A-10 | | | | | | | | | | |
| a-63-I/94-A-10 | | | | | | | | | | |
| c-07-I/94-A-10 | | | | | | | | | | |
| d-74-I/94-A-10 | | | | | | | | | | |
| a-83-I/94-A-10 | | | | | | | | | | |
| d-95-I/94-A-10 | | | | | | | | | | |
| d-97-I/94-A-10 | | | 1301.5 | -553.8 | TSE | TSE | 1333.5 | | 0.0 | 2.5 |
| c-51-J/94-A-10 | | | 1332.5 | -612.2 | TSE | TSE | | | | |
| a-67-J/94-A-10 | | | 1310.5 | -604.0 | FS | FS | | | | |
| a-29-K/94-A-10 | | | 1387.0 | -662.9 | 1.5 | 4.0 | | 722.6 | | |
| d-51-K/94-A-10 | | | 1310.0 | -623.4 | 3.5 | 6.0 | 1337.0 | 683.1 | 0.0 | 3.5 |
| c-54-K/94-A-10 | | | | | | | | | | |
| a-87-K/94-A-10 | | | | | | | | | | |
| d-87-K/94-A10 | | | 1287.0 | -623.7 | 9.0 | | ? NP | 654.3 | 0.0 | |
| b-56-L/94-A-10 | | | 1368.2 | -669.0 | 0.0 | FS | | 699.2 | | |
| b-24-I/94-A-11 | | | 1425.5 | -699.0 | 1.5 | 11.0 | | 725.0 | | |
| d-36-I/94-A-11 | | | 1365.0 | -674.4 | 5.0 | | | 685.6 | | |
| b-44-I/94-A-11 | NDE | | 1410.0 | -698.7 | 3.0 | | ? NP | 708.3 | 0.0 | |
| d-45-I/94-A-11 | | | 1410.0 | -728.5 | 2.0 | | | 679.5 | | |
| d-46-I/94-A-11 | | | 1358.5 | -682.5 | 8.5 | | | 667.5 | | |
| d-49-I/94-A-11 | | | 1384.1 | -704.1 | | 4.5 | ? NP | | 0.0 | |
| b-56-I/94-A-11 | | | | | | | | | | |
| c-57-I/94-A-11 | | | 1358.5 | -676.2 | 15.0 | | | 667.3 | | |
| 02/d-57-I/94-A-11 | | | 1350.8 | -672.6 | 32.0 | 37.2 | | 646.2 | | |
| d-58-I/94-A-11 | | | 1364.3 | -675.8 | 15.8 | | | 672.7 | | |
| d-59-I/94-A-11 | | | | | | | | | | |
| a-67-I/94-A-11 | | | 1355.7 | -672.3 | 20.5 | 23.2 | | 662.9 | | |
| b-67-I/94-A-11 | | | 1367.0 | -672.1 | 14.0 | | | 680.9 | | |
| a-68-I/94-A-11 | | | 1389.5 | -683.3 | 11.5 | | | 694.7 | | |
| d-68-I/94-A-11 | | | 1389.3 | -674.8 | 23.5 | 26.8 | | 691.0 | | |
| d-69-I/94-A-11 | | | 1443.0 | -694.0 | | 3.0 | | | | |
| d-76-I/94-A-11 | | | 1379.0 | -684.2 | 18.0 | | ? NP | 676.8 | 0.0 | |
| b-77-I/94-A-11 | | | 1371.0 | -670.2 | 15.0 | 22.0 | | 685.8 | | |
| d-79-I/94-A-11 | | | 1401.0 | -689.7 | 4.5 | 14.0 | | 706.8 | | |
| d-85-I/94-A-11 | | | 1392.0 | -668.2 | 22.5 | 14.5 | ? NP | 701.3 | 0.0 | |
| d-86-I/94-A-11 | | | 1393.0 | -658.1 | 27.5 | 30.0 | | 707.4 | | |
| d-93-I/94-A-11 | | | 1347.0 | -672.3 | 5.5 | 20.0 | | 669.2 | | |
| 02/d-96-I/94-A-11 | | | 1388.0 | -652.9 | 28.5 | 33.0 | | 706.6 | | |
| 03/d-96-I/94-A-11 | | | 1390.0 | -654.6 | 23.0 | | | 712.4 | | |
| d-98-I/94-A-11 | | | ? NP | | 0.0 | | ? NP | 708.4 | 0.0 | |
| d-33-I/94-A-11 | | | 1408.8 | -723.0 | 0.0 | 3.6 | | 685.8 | | |
| d-52-J/94-A-11 | | | 1464.0 | -704.6 | 0.0 | 12.0 | ? NP | 759.4 | 0.0 | |
| d-55-J/94-A-11 | | | | | | | | | | |
| c-56-J/94-A-11 | | | 1497.2 | -738.9 | | 2.7 | ? NP | | 0.0 | |
| c-79-J/94-A-11 | | | | | | | | | | |
| d-83-J/94-A-11 | | | | | | | | | | |
| b-26-K/94-A-11 | 1902.0 | -1132.5 | ?NP | | 0.0 | | 1573.0 | 769.5 | 4.0 | |
| d-31-K/94-A-11 | | | ?NP | | 0.0 | | 1519.0 | 760.5 | | 6.0 |
| d-33-K/94-A-11 | | | NDE | | | | NDE | | | |
| d-38-K/94-A-11 | | | | | | | | | | |

| WELL ID | DOIG GAS | DOIG OIL | CORE | COMMENTS |
|---|---|---|---|---|
| d-28-I/94-A-10 | | | | questionable Doig, Main Phosphate |
| d-33-I/94-A-10 | | | | |
| d-57-I/94-A-10 | | | | |
| a-63-I/94-A-10 | | | | |
| c-07-I/94-A-10 | | | | |
| d-74-I/94-A-10 | | | | |
| a-83-I/94-A-10 | | | | |
| d-95-I/94-A-10 | | | | |
| d-97-I/94-A-10 | | | | 1301.5 - erosional surface: 1st Doig sand equivalent? |
| c-51-J/94-A-10 | | | | 1332.5 - erosional surface: 1st Doig sand equivalent? |
| a-67-J/94-A-10 | | | | 1310.5 - flooding surface: 1st Doig sand equivalent? |
| a-29-K/94-A-10 | | | HD | 1st Doig sand equivalent - 4.0 m thick |
| d-51-K/94-A-10 | | | | 1st Doig sand equivalent - 6.0 m thick |
| c-54-K/94-A-10 | | | | |
| a-87-K/94-A-10 | | | | |
| d-87-K/94-A10 | | | H | |
| b-56-L/94-A-10 | | | | 1368.2: flooding surface (TSE?) |
| b-24-I/94-A-11 | | | | 1417.0: top Doig parasequence, 1st Doig sand equivalent 11.0 m thick |
| d-36-I/94-A-11 | | | D | 1362.0: TSE (?), 1st Doig sand equivalent 5.0 m thick |
| b-44-I/94-A-11 | | | D | 1407.0: TSE (?) |
| d-45-I/94-A-11 | | | D | 1399.0: top Doig parasequence(?), 1st Doig sand equivalent 2.0 m thick |
| d-46-I/94-A-11 | | X | D | 1367.0: SB (?), 1st Doig sand equivalent 8.5 m thick |
| d-49-I/94-A-11 | | | | 1st Doig sand equivalent 4.5 m silty mud |
| b-56-I/94-A-11 | | X | | Deviated Well - not corrected for TVD (as of July 6th, 1994) |
| c-57-I/94-A-11 | | X | | 1349.0: top Doig parasequence, 1st Doig sand equivalent 15.5 m thick |
| 02/d-57-I/94-A-11 | | X | D | 1350.8: TSE (?), 1st Doig sand equivalent 37.2 m thick |
| d-58-I/94-A-11 | | X | D | 1356.3: top Doig parasequence |
| d-59-I/94-A-11 | | | | |
| a-67-I/94-A-11 | | X | | 1346.9: top Doig parasequence, 1st Doig sand 23.2 m thick, 1378.9: SB(?) |
| b-67-I/94-A-11 | | X | | 1359.0: top Doig parasequence |
| a-68-I/94-A-11 | | X | | 1346.9: top Doig parasequence, 1405.0: SB(?) |
| d-68-I/94-A-11 | | X | D | 1378.3: top Doig parasequence, 1st Doig sand 26.8 m thick, 1416.7: SB(?) |
| d-69-I/94-A-11 | | | D | 1430.5: top Doig parasequence |
| d-76-I/94-A-11 | | X | D | 1356.0: top Doig parasequence, 1398.0: SB, 1367.5: TSE |
| b-77-I/94-A-11 | | X | D | 1359.5: top Doig parasequence, 1st Doig sand 22.0 m thick |
| d-79-I/94-A-11 | | | D | 1392.0: top Doig parasequence, 1st Doig sand 14.0 m silt thickness |
| d-85-I/94-A-11 | | | D | SB @ 1402m |
| d-86-I/94-A-11 | | X | CHD | 1385.0: top Doig parasequence, 1st Doig sand 30.0 m thick |
| d-93-I/94-A-11 | | | | 1343.0: top Doig parasequence, 1st Doig sand 22.0 m silt thickness, log character serrated |
| 02/d-96-I/94-A-11 | | X | CD | 1379.0: top Doig parasequence, 1st Doig sand 33.0 m thick, 1421.0: SB |
| 03/d-96-I/94-A-11 | | X | HD | 1380.0: top Doig parasequence, 1st Doig sand 23.0 m thick |
| d-98-I/94-A-11 | | | | crude quality log |
| d-33-I/94-A-11 | | | | Upper Sand 4.9 m total silt thickness |
| d-52-J/94-A-11 | | | M | |
| d-55-J/94-A-11 | | | | |
| c-56-J/94-A-11 | | | | Upper Sand 4.8 m total silt thickness |
| c-79-J/94-A-11 | | | | |
| d-83-J/94-A-11 | | | | SP/e-log |
| b-26-K/94-A-11 | | | | questionable Doig, Main Phosphate, 1st or 2nd Eqv. ? |
| d-31-K/94-A-11 | | | | |
| d-33-K/94-A-11 | | | | |
| d-38-K/94-A-11 | | | | |

| | WELL ID | | Top Triassic | | Halfway | | Doig | | Montney | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | KB | BLDN | SS | HLFY | SS | DOIG | SS | MNTN | SS |
| • | d-55-K/94-A-11 | 696.8 | 1151.0 | -454.2 | 1420.0 | -723.2 | 1440.0 | -743.2 | 1513.0 | -816.2 |
| | c-16-L/94-A-11 | 805.0 | 1289.3 | -484.3 | 1557.5 | -752.5 | 1603.2 | -798.2 | | |
| • | d-35-L/94-A-11 | 794.1 | 1305.0 | -510.9 | 1586.0 | -791.9 | 1601.0 | -806.9 | | |
| • | d-37-L/94-A-11 | 833.0 | 1320.4 | -487.4 | 1591.7 | -758.7 | 1613.9 | -780.9 | | |
| • | b-48-L/94-A-11 | 788.5 | 1281.5 | -493.0 | 1559.5 | -771.0 | 1582.0 | -793.5 | | |
| • | c-58-L/94-A-11 | 823.6 | 1316.7 | -493.1 | 1588.6 | -765.0 | 1613.0 | -789.4 | | |
| • | d-68-L/94-A-11 | 823.9 | 1318.6 | -494.7 | 1594.1 | -770.2 | 1617.3 | -793.4 | 1702.0 | -878.1 |
| • | c-80-L/94-A-11 | 770.5 | 1280.5 | -510.0 | 1563.5 | -793.0 | 1583.0 | -812.5 | NDE | |
| • | d-93-L/94-A-11 | 782.1 | 1269.2 | -487.1 | 1549.5 | -767.4 | 1573.6 | -791.5 | | |
| • | d-95-L/94-A-11 | 833.3 | 1334.1 | -500.8 | 1605.6 | -772.3 | 1620.2 | -786.9 | | |
| | c-32-I/94-A-12 | 801.9 | 1310.6 | -508.7 | 1591.1 | -789.2 | 1612.4 | -810.5 | | |
| | d-37-I/94-A-12 | 788.5 | 1298.4 | -509.9 | 1581.9 | -793.4 | 1605.7 | -817.2 | | |
| • | b-62-I/94-A-12 | 818.4 | 1313.5 | -495.1 | 1587.0 | -768.6 | 1611.0 | -792.6 | NDE | |
| • | b-64-I/94-A-12 | 853.1 | 1350.0 | -496.9 | 1638.0 | -784.9 | 1654.0 | -800.9 | NDE | |
| • | d-77-I/94-A-12 | 845.0 | 1348.0 | -503.0 | 1636.0 | -791.0 | 1657.0 | -812.0 | ? 1736 | -891.0 |
| | b-82-I/94-A-12 | 792.5 | 1284.4 | -491.9 | 1551.4 | -758.9 | 1574.6 | -782.1 | | |
| • | c-32-J/94-A-12 | 843.3 | 1355.0 | -511.7 | 1645.0 | -801.7 | 1677.0 | -833.7 | 1772.0 | -928.7 |
| | b-82-J/94-A-12 | 831.8 | 1350.0 | -518.2 | 1632.5 | -800.7 | | | | |
| | d-09-K/94-A-12 | 731.5 | 1214.0 | -482.5 | 1533.8 | -802.3 | 1569.7 | -838.2 | 1670.3 | -938.8 |
| | b-18-K/94-A-12 | 799.2 | 1275.0 | -475.8 | 1578.3 | -779.1 | 1625.8 | -826.6 | 1722.1 | -922.9 |
| | b-18-K/94-A-12/02 | 799.2 | 1275.0 | -475.8 | 1578.3 | -779.1 | 1625.8 | -826.6 | 1722.1 | -922.9 |
| | d-19-K/94-A-12 | 751.9 | 1235.7 | -483.8 | 1545.3 | -793.4 | 1587.4 | -835.5 | 1682.5 | -930.6 |
| | c-29-K/94-A-12 | 781.5 | 1258.8 | -477.3 | 1565.1 | -783.6 | 1609.3 | -827.8 | 1700.8 | -919.3 |
| | d-30-K/94-A-12 | 748.3 | 1246.6 | -498.3 | 1555.1 | -806.8 | 1603.2 | -854.9 | 1699.3 | -951.0 |
| | b-39-K/94-A-12 | 792.5 | 1269.0 | -476.5 | 1566.0 | -773.5 | 1620.0 | -827.5 | 1710.0 | -917.5 |
| • | d-40-K/94-A-12 | 755.0 | 1234.4 | -479.4 | 1545.9 | -790.9 | 1592.3 | -837.3 | 1688.0 | -933.0 |
| | d-45-K/94-A-12 | 926.3 | 1492.6 | -566.3 | 1789.2 | -862.9 | 1841.0 | -914.7 | | |
| | a-50-K/94-A-12 | 799.2 | 1273.0 | -473.8 | 1575.0 | -775.8 | 1625.0 | -825.8 | 1717.0 | -917.8 |
| | d-50-K/94-A-12 | 834.5 | 1308.5 | -474.0 | 1594.1 | -759.6 | 1655.7 | -821.2 | 1748.9 | -914.4 |
| | b-60-K/94-A-12 | 798.0 | 1288.1 | -490.1 | 1589.8 | -791.8 | 1639.8 | -841.8 | 1731.3 | -933.3 |
| | c-60-K/94-A-12 | 796.9 | | | 1577.0 | -780.1 | 1705.0 | -908.1 | 1718.0 | -921.1 |
| | b-100-K/94-A-12 | 936.3 | 1472.2 | -535.9 | 1771.5 | -835.2 | 1818.7 | -882.4 | 1908.0 | -971.7 |
| | d-19-L/94-A-12 | 759.0 | 1228.3 | -469.3 | 1554.5 | -795.5 | 1609.3 | -850.3 | 1700.8 | -941.8 |
| • | a-39-L/94-A-12 | 773.4 | 1237.0 | -463.6 | 1552.0 | -778.6 | 1605.0 | -831.6 | 1695.0 | -921.6 |
| | d-41-L/94-A-12 | 759.6 | 1259.4 | -499.8 | 1568.5 | -808.9 | 1621.5 | -861.9 | 1712.4 | -952.8 |
| | a-61-L/94-A-12 | 865.3 | 1355.8 | -490.5 | 1655.7 | -790.4 | 1706.9 | -841.6 | 1798.3 | -933.0 |
| | c-71-L/94-A-12 | 880.6 | 1370.4 | -489.8 | 1660.6 | -780.0 | 1715.1 | -834.5 | 1804.4 | -923.8 |
| | d-82-L/94-A-12 | 853.1 | 1347.2 | -494.1 | 1667.3 | -814.2 | 1695.0 | -841.9 | 1775.8 | -922.7 |
| | b-92-L/94-A-12 | 806.2 | 1307.6 | -501.4 | 1604.8 | -798.6 | 1658.1 | -851.9 | 1747.1 | -940.9 |
| | d-93-L/94-A-12 | 801.6 | 1309.7 | -508.1 | 1603.9 | -802.3 | 1651.1 | -849.5 | 1745.9 | -944.3 |
| • | b-06-A/94-A-13 | 827.2 | 1308.2 | -481.0 | 1583.7 | -756.5 | 1598.4 | -771.2 | 1694.1 | -866.9 |
| • | b-10-A/94-A-13 | 818.4 | 1320.4 | -502.0 | 1596.2 | -777.8 | 1614.1 | -795.7 | 1702.5 | -884.1 |
| | c-35-A/94-A-13 | 837.8 | | | 1574.0 | -736.2 | 1585.9 | -748.1 | | |
| • | b-42-A/94-A-13 | 835.5 | 1309.4 | -473.9 | 1576.4 | -740.9 | 1589.2 | -753.7 | 1677.6 | -842.1 |
| • | b-48-A/94-A-13 | 831.5 | 1320.0 | -488.5 | 1597.0 | -765.5 | 1612.0 | -780.5 | | |
| • | a-57-A/94-A-13 | 842.2 | 1305.5 | -463.3 | 1573.6 | -731.4 | 1589.1 | -746.9 | 1671.8 | -829.6 |
| • | d-75-A/94-A-13 | 857.7 | 1334.1 | -476.4 | 1592.8 | -735.1 | 1604.7 | -747.0 | 1693.4 | -835.7 |
| | a-05-B/94-A-13 | 822.7 | 1325.9 | -503.2 | 1594.7 | -772.0 | 1624.0 | -801.3 | | |
| | 02/a-05-B/94-A-13 | 813.9 | 1315.0 | -501.1 | 1572.0 | -758.1 | 1624.0 | -810.1 | 1704.0 | -890.1 |
| | c-26-B/94-A-13 | 807.4 | 1309.0 | -501.6 | 1561.0 | -753.6 | 1614.0 | -806.6 | | |
| | b-46-B/94-A-13 | 782.4 | 1288.1 | -505.7 | 1543.2 | -760.8 | 1589.5 | -807.1 | 1679.4 | -897.0 |
| • | a-47-B/94-A-13 | 804.0 | 1306.0 | -502.0 | 1569.0 | -765.0 | 1609.0 | -805.0 | 1696.0 | -892.0 |

| WELL ID | Base Triassic | | 1st Doig Sand | | Thickness | | 2nd Doig Sand | | Thickness | |
|---|---|---|---|---|---|---|---|---|---|---|
| | BLLY | SS | 1st Sand | SS | Sand | Silt Eq. | 2nd Sand | SS | Sand | Silt Eq. |
| d-55-K/94-A-11 | 1770.0 | -1073.2 | ?NP | | 0.0 | | 1457.0 | 696.8 | | 4.0 |
| c-16-L/94-A-11 | | | | | | | | | | |
| d-35-L/94-A-11 | | | | | | | 1616.0 | | 5.0 | |
| d-37-L/94-A-11 | | | | | | | 1628.9 | | 11.3 | |
| b-48-L/94-A-11 | | | 1614.0 | -825.5 | 0.0 | 4.0 | 1594.5 | 788.5 | 5.0 | |
| c-58-L/94-A-11 | | | 1649.6 | -826.0 | 2.7 | 6.1 | 1642.3 | 820.9 | 0.0 | 1.8 |
| d-68-L/94-A-11 | 1956.2 | -1132.3 | ?NP | | 0.0 | | 1647.1 | 823.9 | 0.0 | 3.0 |
| c-80-L/94-A-11 | | | | | | | 1607.0 | | 3.0 | 7.0 |
| d-93-L/94-A-11 | | | NDE | | | | NDE | | | |
| d-95-L/94-A-11 | | | NDE | | | | NDE | | | |
| c-32-I/94-A-12 | | | | | | | | | | |
| d-37-I/94-A-12 | | | | | | | | | | |
| b-62-I/94-A-12 | | | 1644.0 | -825.6 | 0.0 | 4.0 | 1630.0 | 818.4 | | 14.0 |
| b-64-I/94-A-12 | | | 1694.0 | -840.9 | 2.3 | | 1673.0 | 850.8 | 7.5 | 12.0 |
| d-77-I/94-A-12 | | | NP | | 0.0 | 0.0 | 1670.0 | 845.0 | 4.0 | 11.0 |
| b-82-I/94-A-12 | | | | | | | | | | |
| c-32-J/94-A-12 | 2045.0 | -1201.7 | NP | | 0.0 | 0.0 | NP | 843.3 | 0.0 | 0.0 |
| b-82-J/94-A-12 | | | | | | | | | | |
| d-09-K/94-A-12 | 1972.1 | -1240.6 | | | | | | | | |
| b-18-K/94-A-12 | 2020.2 | -1221.0 | | | | | | | | |
| b-18-K/94-A-12/02 | 2020.2 | -1221.0 | | | | | | | | |
| d-19-K/94-A-12 | 1975.4 | -1223.5 | | | | | | | | |
| c-29-K/94-A-12 | 1987.0 | -1205.5 | | | | | | | | |
| d-30-K/94-A-12 | 1987.6 | -1239.3 | | | | | | | | |
| b-39-K/94-A-12 | 1994.0 | -1201.5 | | | | | | | | |
| d-40-K/94-A-12 | 1972.7 | -1217.7 | ? NP | | 0.0 | | ? NP | 755.0 | 0.0 | |
| d-45-K/94-A-12 | | | | | | | | | | |
| a-50-K/94-A-12 | 2004.0 | -1204.8 | | | | | | | | |
| d-50-K/94-A-12 | 2030.9 | -1196.4 | | | | | | | | |
| b-60-K/94-A-12 | 2020.2 | -1222.2 | | | | | | | | |
| c-60-K/94-A-12 | 2008.0 | -1211.1 | | | | | | | | |
| b-100-K/94-A-12 | 2188.5 | -1252.2 | | | | | | | | |
| d-19-L/94-A-12 | 2002.5 | -1243.5 | | | | | | | | |
| a-39-L/94-A-12 | 1987.0 | -1213.6 | ? NP | | 0.0 | | ? NP | 773.4 | 0.0 | |
| d-41-L/94-A-12 | 1994.0 | -1234.4 | | | | | | | | |
| a-61-L/94-A-12 | 2097.0 | -1231.7 | | | | | | | | |
| c-71-L/94-A-12 | 2086.4 | -1205.8 | | | | | | | | |
| d-82-L/94-A-12 | 2069.6 | -1216.5 | | | | | | | | |
| b-92-L/94-A-12 | 2026.9 | -1220.7 | | | | | | | | |
| d-93-L/94-A-12 | 2023.0 | -1221.4 | | | | | | | | |
| b-06-A/94-A-13 | 1945.5 | -1118.3 | ?NP | | 0.0 | | 1616.4 | 827.2 | 0.0 | 27.7 |
| b-10-A/94-A-13 | 1953.8 | -1135.4 | 1661.5 | -843.1 | 0.0 | FS | 1636.8 | 818.4 | 0.0 | 3.0 |
| c-35-A/94-A-13 | | | | | | | 1599.5 | | 5.0 | |
| b-42-A/94-A-13 | 1915.4 | -1079.9 | 1636.8 | -801.3 | 0.0 | 7.0 | 1602.0 | 835.5 | 18.3 | |
| b-48-A/94-A-13 | | | | | | | | | | |
| a-57-A/94-A-13 | 1917.2 | -1075.0 | ? | | | | ? | | | |
| d-75-A/94-A-13 | 1933.0 | -1075.3 | ? | | | | ? | | | |
| a-05-B/94-A-13 | 1973.0 | -1150.3 | | | | | | | | |
| 02/a-05-B/94-A-13 | | | | | | | | | | |
| c-26-B/94-A-13 | | | | | | | | | | |
| b-46-B/94-A-13 | 1942.2 | -1159.8 | | | | | | | | |
| a-47-B/94-A-13 | 1950.0 | -1146.0 | 1651.0 | -847.0 | 0.0 | 3.5 | ?NP | 804.0 | 0.0 | 0.0 |

| WELL ID | DOIG | DOIG | CORE | COMMENTS |
|---|---|---|---|---|
| | GAS | OIL | | |
| d-55-K/94-A-11 | | | | 1st or 2nd Eqv. ? |
| c-16-L/94-A-11 | | | | |
| d-35-L/94-A-11 | | | | |
| d-37-L/94-A-11 | | | | |
| b-48-L/94-A-11 | | | | |
| c-58-L/94-A-11 | | | | |
| d-68-L/94-A-11 | | | | |
| c-80-L/94-A-11 | | | | 2ND Doig Sand Equivalent = 6.0 m thick |
| d-93-L/94-A-11 | | | | |
| d-95-L/94-A-11 | | | | |
| c-32-I/94-A-12 | | | | |
| d-37-I/94-A-12 | | | | |
| b-62-I/94-A-12 | X | | | |
| b-64-I/94-A-12 | X | X | D | 2ND Doig Sand Equivalent = 12.0 m thick: SB - 1700 (?) |
| d-77-I/94-A-12 | | | | 2ND Doig Sand Equivalent = 14.5 m thick: SB - 1702 (?): questionable Montney pick |
| b-82-I/94-A-12 | | | | |
| c-32-J/94-A-12 | | | | |
| b-82-J/94-A-12 | | | | |
| d-09-K/94-A-12 | | | | |
| b-18-K/94-A-12 | | | | |
| b-18-K/94-A-12/02 | | | | |
| d-19-K/94-A-12 | | | | |
| c-29-K/94-A-12 | | | | |
| d-30-K/94-A-12 | | | | |
| b-39-K/94-A-12 | | | | |
| d-40-K/94-A-12 | | | | |
| d-45-K/94-A-12 | | | | |
| a-50-K/94-A-12 | | | | |
| d-50-K/94-A-12 | | | | |
| b-60-K/94-A-12 | | | | |
| c-60-K/94-A-12 | | | | |
| b-100-K/94-A-12 | | | | |
| d-19-L/94-A-12 | | | | |
| a-39-L/94-A-12 | | | | |
| d-41-L/94-A-12 | | | | |
| a-61-L/94-A-12 | | | | |
| c-71-L/94-A-12 | | | | |
| d-82-L/94-A-12 | | | | |
| b-92-L/94-A-12 | | | | |
| d-93-L/94-A-12 | | | | |
| b-06-A/94-A-13 | | | | 2ND Doig sand Equivalent = thick, diffuse(?) silty mud |
| b-10-A/94-A-13 | | | | |
| c-35-A/94-A-13 | | | | |
| b-42-A/94-A-13 | | | | 2ND Doig sand Equivalent = dirty, serrated log signature: questionable base Triassic pick |
| b-48-A/94-A-13 | | | | |
| a-57-A/94-A-13 | | | | |
| d-75-A/94-A-13 | | | | |
| a-05-B/94-A-13 | | | | questionable base Triassic Pick |
| 02/a-05-B/94-A-13 | | | | |
| c-26-B/94-A-13 | | | | |
| b-46-B/94-A-13 | | | | questionable base Triassic Pick |
| a-47-B/94-A-13 | | | | questionable 1st Phosphate pick |

|  | WELL ID |  | Top Triassic |  | Halfway |  | Doig |  | Montney |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  | KB | BLDN | SS | HLFY | SS | DOIG | SS | MNTN | SS |
|  | c-58-B/94-A-13 | 865.2 | 1378.0 | -512.8 | 1645.0 | -779.8 | 1684.0 | -818.8 | 1773.0 | -907.8 |
|  | c-78-B/94-A-13 | 825.7 | 1340.8 | -515.1 | 1603.9 | -778.2 | 1641.7 | -816.0 | 1740.4 | -914.7 |
|  | b-36-C/94-A-13 | 837.6 | 1378.9 | -541.3 | 1645.9 | -808.3 | 1699.0 | -861.4 | 1785.5 | -947.9 |
|  | b-38-C/94-A-13 | 879.0 | 1421.9 | -542.9 | 1705.4 | -826.4 | 1748.0 | -869.0 | 1831.5 | -952.5 |
|  | d-47-C/94-A-13 | 897.6 | 1439.3 | -541.7 | 1722.1 | -824.5 |  |  |  |  |
|  | b-88-C/94-A-13 | 881.5 | 1428.0 | -546.5 | 1691.6 | -810.1 | 1746.2 | -864.7 |  |  |
|  | d-11-D/94-A-13 | 917.5 | 1436.3 | -518.8 | 1727.0 | -809.5 | 1776.0 | -858.5 |  |  |
|  | b-13-D/94-A-13 | 828.1 | 1338.1 | -510.0 | 1631.6 | -803.5 | 1682.5 | -854.4 | 1777.0 | -948.9 |
|  | b-22-D/94-A-13 | 889.4 | 1379.5 | -490.1 | 1664.2 | -774.8 | 1713.0 | -823.6 | 1803.8 | -914.4 |
|  | b-24-D/94-A-13 | 931.5 | 1450.8 | -519.3 | 1744.1 | -812.6 | 1794.1 | -862.6 | 1884.6 | -953.1 |
|  | d-25-D/94-A-13 | 954.0 | 1473.1 | -519.1 | 1767.8 | -813.8 | 1817.5 | -863.5 | 1906.8 | -952.8 |
|  | a-34-D/94-A-13 | 872.0 | 1356.4 | -484.4 | 1649.0 | -777.0 | 1689.5 | -817.5 | 1780.0 | -908.0 |
|  | b-35-D/94-A-13 | 967.1 | 1485.0 | -517.9 | 1781.9 | -814.8 | 1831.8 | -864.7 | 1919.3 | -952.2 |
| • | d-36-D/94-A-13 | 955.5 | 1478.9 | -523.4 | 1770.9 | -815.4 | 1821.8 | -866.3 | 1911.1 | -955.6 |
|  | d-46-D/94-A-13 | 943.1 | 1452.4 | -509.3 | 1740.7 | -797.6 | 1787.7 | -844.6 | 1869.0 | -925.9 |
|  | d-57-D/94-A-13 | 980.8 | 1506.3 | -525.5 | 1807.5 | -826.7 | 1852.6 | -871.8 | 1942.2 | -961.4 |
|  | c-65-D/94-A-13 | 920.8 | 1388.4 | -467.6 | 1673.4 | -752.6 | 1713.0 | -792.2 | 1806.9 | -886.1 |
|  | d-68-D/94-A-13 | 935.7 | 1471.0 | -535.3 | 1765.0 | -829.3 | 1812.0 | -876.3 | 1901.0 | -965.3 |
|  | d-99-D/94-A-13 | 869.6 | 1387.4 | -517.8 | 1676.1 | -806.5 | 1723.6 | -854.0 | 1813.6 | -944.0 |
| • | d-06-A/94-A-14 | 705.7 |  |  | 1340.5 | -634.8 | 1354.0 | -648.3 | 1417.0 | -711.3 |
| • | d-26-A/94-A-14 | 703.7 | 1130.0 | -426.3 | 1337.0 | -633.3 | 1347.0 | -643.3 | 1408.0 | -704.3 |
|  | a-31-A/94-A-14 | 729.7 | 1158.2 | -428.5 | 1363.1 | -633.4 | 1380.1 | -650.4 |  |  |
| • | d-35-A/94-A-14 | 679.9 | 1126.0 | -446.1 | 1336.5 | -656.6 | 1343.0 | -663.1 | 1403.0 | -723.1 |
| • | d-58-A/94-A-14 | 758.4 |  |  | 1362.0 | -603.6 | 1374.0 | -615.6 | 1434.0 | -675.6 |
|  | c-16-B/94-A-14 | 740.1 | 1175.9 | -435.8 | 1408.8 | -668.7 | 1429.2 | -689.1 |  |  |
| • | c-35-B/94-A-14 | 778.4 | 1192.0 | -413.6 | 1425.5 | -647.1 | 1442.0 | -663.6 | 1507.0 | -728.6 |
|  | c-87-B/94-A-14 | 773.3 | 1179.6 | -406.3 | 1396.0 | -622.7 | 1431.0 | -657.7 | 1487.4 | -714.1 |
|  | c-05-C/94-A-14 | 786.7 | 1207.0 | -420.3 | 1463.0 | -676.3 |  |  |  |  |
| • | b-08-C/94-A-14 | 700.1 | 1152.1 | -452.0 | 1415.5 | -715.4 | 1434.1 | -734.0 |  |  |
| • | d-37-C/94-A-14 | 769.3 | 1185.7 | -416.4 | 1450.1 | -680.8 | 1466.7 | -697.4 |  |  |
|  | b-78-C/94-A-14 | 793.7 | 1204.0 | -410.3 | 1450.8 | -657.1 | 1482.9 | -689.2 | 1550.5 | -756.8 |
| • | b-06-D/94-A-14 | 817.0 | 1311.0 | -494.0 | 1586.0 | -769.0 | 1602.0 | -785.0 | NDE |  |
| • | d-15-D/94-A-14 | 821.7 | 1317.0 | -495.3 | 1588.0 | -766.3 | 1604.0 | -782.3 | NDE |  |
| • | b-26-D/94-A-14 | 833.3 | 1326.5 | -493.2 | 1608.4 | -775.1 | 1620.9 | -787.6 | NDE |  |
| • | b-28-D/94-A-14 | 837.0 | 1344.0 | -507.0 | 1623.5 | -786.5 | 1637.0 | -800.0 |  |  |
| • | d-37-D/94-A-14 | 802.8 | 1304.0 | -501.2 | 1579.0 | -776.2 | 1592.0 | -789.2 | 1680.0 | -877.2 |
| • | d-39-D/94-A-14 | 831.5 | 1328.9 | -497.4 | 1599.6 | -768.1 | 1613.9 | -782.4 | NDE |  |
| • | b-68-D/94-A-14 | 820.2 | 1292.0 | -471.8 | 1552.0 | -731.8 | 1565.0 | -744.8 | 1652.0 | -831.8 |
| • | c-74-D/94-A-14 | 718.7 | 1161.0 | -442.3 | 1430.0 | -711.3 | 1445.0 | -726.3 | NDE |  |
|  | b-91-D/94-A-14 | 787.6 | 1200.9 | -413.3 | 1443.5 | -655.9 |  |  |  |  |
|  | c-02-E/94-A-14 | 776.6 | 1179.6 | -403.0 | 1441.7 | -665.1 |  |  |  |  |
| • | a-07-E/94-A-14 | 720.2 | 1160.0 | -439.8 | 1414.5 | -694.3 | 1432.0 | -711.8 |  |  |
| • | d-17-E/94-A-14 | 727.9 | 1164.9 | -437.0 | 1412.7 | -684.8 | 1426.5 | -698.6 |  |  |
|  | b-23-E/94-A-14 | 785.8 | 1182.6 | -396.8 | 1434.7 | -648.9 | 1449.3 | -663.5 |  |  |
| • | c-32-E/94-A-14 | 808.3 | 1231.4 | -423.1 | 1476.4 | -668.1 | 1499.5 | -691.2 | 1569.7 | -761.4 |
|  | c-34-E/94-A-14 | 818.7 | 1230.8 | -412.1 | 1470.7 | -652.0 | 1488.6 | -669.9 |  |  |
| • | a-41-E/94-A-14 | 832.4 | 1252.1 | -419.7 | 1492.2 | -659.8 | 1512.4 | -680.0 |  |  |
|  | c-87-E/94-A-14 | 797.1 | 1228.3 | -431.2 | 1453.9 | -656.8 | 1466.7 | -669.6 |  |  |
|  | b-06-F/94-A-14 | 808.9 | 1235.0 | -426.1 | 1475.0 | -666.1 | 1495.0 | -686.1 |  |  |
|  | d-33-F/94-A-14 | 786.4 | 1194.2 | -407.8 | 1413.7 | -627.3 | 1444.8 | -658.4 |  |  |
|  | d-79-F/94-A-14 | 781.8 | 1204.0 | -422.2 | 1426.0 | -644.2 | 1450.5 | -668.7 |  |  |
| • | b-56-D/94-A-15 | 671.0 |  |  | 1284.0 | -613.0 | 1292.5 | -621.5 |  |  |

| WELL ID | Base Triassic | | 1st Doig Sand | | Thickness | | 2nd Doig Sand | | Thickness | |
|---|---|---|---|---|---|---|---|---|---|---|
| | BLLY | SS | 1st Sand | SS | Sand | Silt Eq. | 2nd Sand | SS | Sand | Silt Eq. |
| c-58-B/94-A-13 | 2025.0 | -1159.8 | | | | | | | | |
| c-78-B/94-A-13 | 1986.7 | -1161.0 | | | | | | | | |
| b-36-C/94-A-13 | 2053.1 | -1215.5 | | | | | | | | |
| b-38-C/94-A-13 | 2109.2 | -1230.2 | | | | | | | | |
| d-47-C/94-A-13 | | | | | | | | | | |
| b-88-C/94-A-13 | | | | | | | | | | |
| d-11-D/94-A-13 | | | | | | | | | | |
| b-13-D/94-A-13 | 2050.7 | -1222.6 | | | | | | | | |
| b-22-D/94-A-13 | 2148.8 | -1259.4 | | | | | | | | |
| b-24-D/94-A-13 | 2161.6 | -1230.1 | | | | | | | | |
| d-25-D/94-A-13 | 2182.1 | -1228.1 | | | | | | | | |
| a-34-D/94-A-13 | 2058.0 | -1186.0 | | | | | | | | |
| b-35-D/94-A-13 | 2197.3 | -1230.2 | | | | | | | | |
| d-36-D/94-A-13 | 2187.2 | -1231.7 | 1865.4 | -909.9 | | SONIC | 1845.9 | | ? 3 | 3.5 |
| d-46-D/94-A-13 | 2158.0 | -1214.9 | | | | | | | | |
| d-57-D/94-A-13 | 2211.0 | -1230.2 | | | | | | | | |
| c-65-D/94-A-13 | 2092.8 | -1172.0 | | | | | | | | |
| d-68-D/94-A-13 | 2176.0 | -1240.3 | | | | | | | | |
| d-99-D/94-A-13 | 2090.9 | -1221.3 | | | | | | | | |
| d-06-A/94-A-14 | | | 1360.0 | -654.3 | 19.5 | | ? NP | 686.2 | 0.0 | |
| d-26-A/94-A-14 | 1655.0 | -951.3 | 1353.0 | -649.3 | 14.0 | 19.0 | ? NP | 689.7 | 0.0 | |
| a-31-A/94-A-14 | | | | | | | | | | |
| d-35-A/94-A-14 | | | 1355.0 | -675.1 | 31.0 | | ? NP | 648.9 | 0.0 | |
| d-58-A/94-A-14 | | | 1380.0 | -621.6 | ? 12 | 12.0 | ? NP | | 0.0 | |
| c-16-B/94-A-14 | | | | | | | | | | |
| c-35-B/94-A-14 | | | 1463.5 | -685.1 | | 11.0 | ? NP | | 0.0 | |
| c-87-B/94-A-14 | | | | | | | | | | |
| c-05-C/94-A-14 | | | | | | | | | | |
| b-08-C/94-A-14 | | | ?NDE | | | | 1445.4 | | 4.9 | |
| d-37-C/94-A-14 | | | NDE | | | | 1482.5 | | 0.0 | 1.5 |
| b-78-C/94-A-14 | 1789.2 | -995.5 | | | | | | | | |
| b-06-D/94-A-14 | | | ? NP | | 0.0 | | 1633.0 | 817.0 | 11.5 | |
| d-15-D/94-A-14 | | | NP | | 0.0 | 0.0 | 1625.0 | 821.7 | 0.0 | 8.0 |
| b-26-D/94-A-14 | | | | | | | 1650.8 | | 17.0 | |
| b-28-D/94-A-14 | | | | | | | 1658.0 | | 5.0 | |
| d-37-D/94-A-14 | | | NP | | 0.0 | 0.0 | 1615.5 | 802.8 | 2.5 | |
| d-39-D/94-A-14 | | | | | | | ?1631.3 | -779.8 | 7.5 | |
| b-68-D/94-A-14 | 1894.0 | -1073.8 | NP | | 0.0 | 0.0 | ?1580 | -759.8 | 9.0 | |
| c-74-D/94-A-14 | | | NDE | | | | ?1466 | -747.3 | 0.5 | 4.0 |
| b-91-D/94-A-14 | | | | | | | | | | |
| c-02-E/94-A-14 | | | | | | | | | | |
| a-07-E/94-A-14 | | | ? | | | | | | | |
| d-17-E/94-A-14 | | | ? | | | | | | | |
| b-23-E/94-A-14 | | | | | | | | | | |
| c-32-E/94-A-14 | 1795.3 | -987.0 | ?1504.4 | -696.1 | 1.2 | | | 807.1 | | |
| c-34-E/94-A-14 | | | | | | | | | | |
| a-41-E/94-A-14 | | | ?1516.3 | -6883.9 | 2.1 | | | 830.3 | | |
| c-87-E/94-A-14 | | | | | | | | | | |
| b-06-F/94-A-14 | | | | | | | | | | |
| d-33-F/94-A-14 | | | | | | | | | | |
| d-79-F/94-A-14 | | | | | | | | | | |
| b-56-D/94-A-15 | | | 1296.3 | -625.3 | 1.0 | 6.0 | ? NP | 670.0 | 0.0 | |

| WELL ID | DOIG | DOIG | CORE | COMMENTS |
|---|---|---|---|---|
| | GAS | OIL | | |
| c-58-B/94-A-13 | | | | |
| c-78-B/94-A-13 | | | | questionable base Triassic Pick |
| b-36-C/94-A-13 | | | | |
| b-38-C/94-A-13 | | | | |
| d-47-C/94-A-13 | | | | |
| b-88-C/94-A-13 | | | | |
| d-11-D/94-A-13 | | | | |
| b-13-D/94-A-13 | | | | |
| b-22-D/94-A-13 | | | | |
| b-24-D/94-A-13 | | | | |
| d-25-D/94-A-13 | | | | |
| a-34-D/94-A-13 | | | | |
| b-35-D/94-A-13 | | | | |
| d-36-D/94-A-13 | | | | |
| d-46-D/94-A-13 | | | | |
| d-57-D/94-A-13 | | | | |
| c-65-D/94-A-13 | | | | |
| d-68-D/94-A-13 | | | | |
| d-99-D/94-A-13 | | | | |
| d-06-A/94-A-14 | | X | D | 1380.0: SB(?), 1360.0: TSE |
| d-26-A/94-A-14 | | X | D | Upper Sand silty, 1st Doig sand total 19.0 m silty equivalent |
| a-31-A/94-A-14 | | | | |
| d-35-A/94-A-14 | | X | D | 1381.5: SB(?), 1355.0: TSE |
| d-58-A/94-A-14 | | | D | |
| c-16-B/94-A-14 | | | | |
| c-35-B/94-A-14 | | | | 1st Doig sand equivalent totals 27.0 m silty mud |
| c-87-B/94-A-14 | | | | |
| c-05-C/94-A-14 | | | | |
| b-08-C/94-A-14 | | | | 1ST OR 2ND EQV. ? |
| d-37-C/94-A-14 | | | | 2ND Doig sand contains 2 discrete intervals, 1st or 2nd Eqv. ? |
| b-78-C/94-A-14 | | | | questionable base Triassic pick |
| b-06-D/94-A-14 | | X | D | SB - 1648.5: TSE - 1633.5 (?) |
| d-15-D/94-A-14 | | | D | questionable 2ND Doig sand |
| b-26-D/94-A-14 | | X | D | SB - 1669.1: TSE - 1659.8 (?): questionable 1st Doig Sand |
| b-28-D/94-A-14 | | | | |
| d-37-D/94-A-14 | | | D | questionable Upper Sand |
| d-39-D/94-A-14 | | | | questionable Main Phosphate pick |
| b-68-D/94-A-14 | | | | questionable Montney, base Triassic picks |
| c-74-D/94-A-14 | | | | questionable Upper Sand pick (=1452?): 2ND Doig sand= 4.0 m silt |
| b-91-D/94-A-14 | | | | |
| c-02-E/94-A-14 | | | | |
| a-07-E/94-A-14 | | | | |
| d-17-E/94-A-14 | | | | |
| b-23-E/94-A-14 | | | | |
| c-32-E/94-A-14 | | | | Questionable base Triassic pick, 1st or 2nd Eqv. ? |
| c-34-E/94-A-14 | | | | |
| a-41-E/94-A-14 | | | | 1st or 2nd Eqv. ? |
| c-87-E/94-A-14 | | | | |
| b-06-F/94-A-14 | | | | |
| d-33-F/94-A-14 | | | | |
| d-79-F/94-A-14 | | | | |
| b-56-D/94-A-15 | | | CH | TSE(?) @ 1292.5m: SB @ 1303m |

# APPENDIX F: DOIG STUDY
# DRILL CORE DESCRIPTIONS

p. 142

WELL NAME: Esso et al Scott 3-18

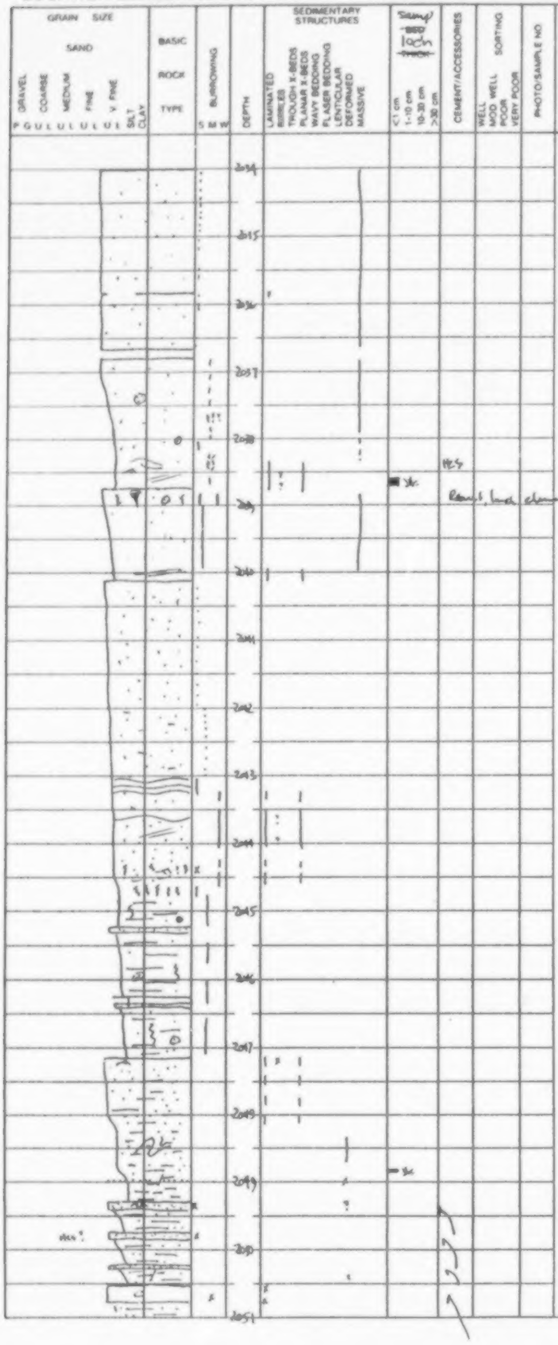
FORMATION: Doig

DATE: June 20/94

LOCATION: B-18-30 17 /w6

CORE INTERVAL: 2034 - 2055.6m

KB: 739.6



GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
Samp ~~BED~~ 10cm ~~THICK~~
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
2034
2035
2036
2037
2038
2039
2040
2041
2042
2043
2044
2045
2046
2047
2048
2049
2050
2051
HCS
3c
3c
mu?

COMMENTS

FACIES/DEP ENVIRONMENT

Rare?, lined elements, Ray

v. fine sand
weakly calc.
gradly msv or structureless

rare, preserved, walled/lined burrows
→ both vert/horiz. elements

3 crude coarsening up cycles
2034 - 2038.76 ⎤
2038.76 - 2040.9 ⎥ lower - upper v fine.
2040.11 - ≈ 2043 ⎦

rare planell to ⨯d⅜ x lam

poss ripple drift x-lam.

variably burrowed to laminated
v fine silty sand / mud.

plane ll lam
↓ X lam
poss ripple lam.
planolites, paleophycus, skolithos
fugichnia, Ray? Th?
unidentified repichnia / fodichnia

locally mottled to churned.

coarsening up silty mud → lower v fine sand
@ 2047.14 - 2049.31

[illegible]

WELL NAME:

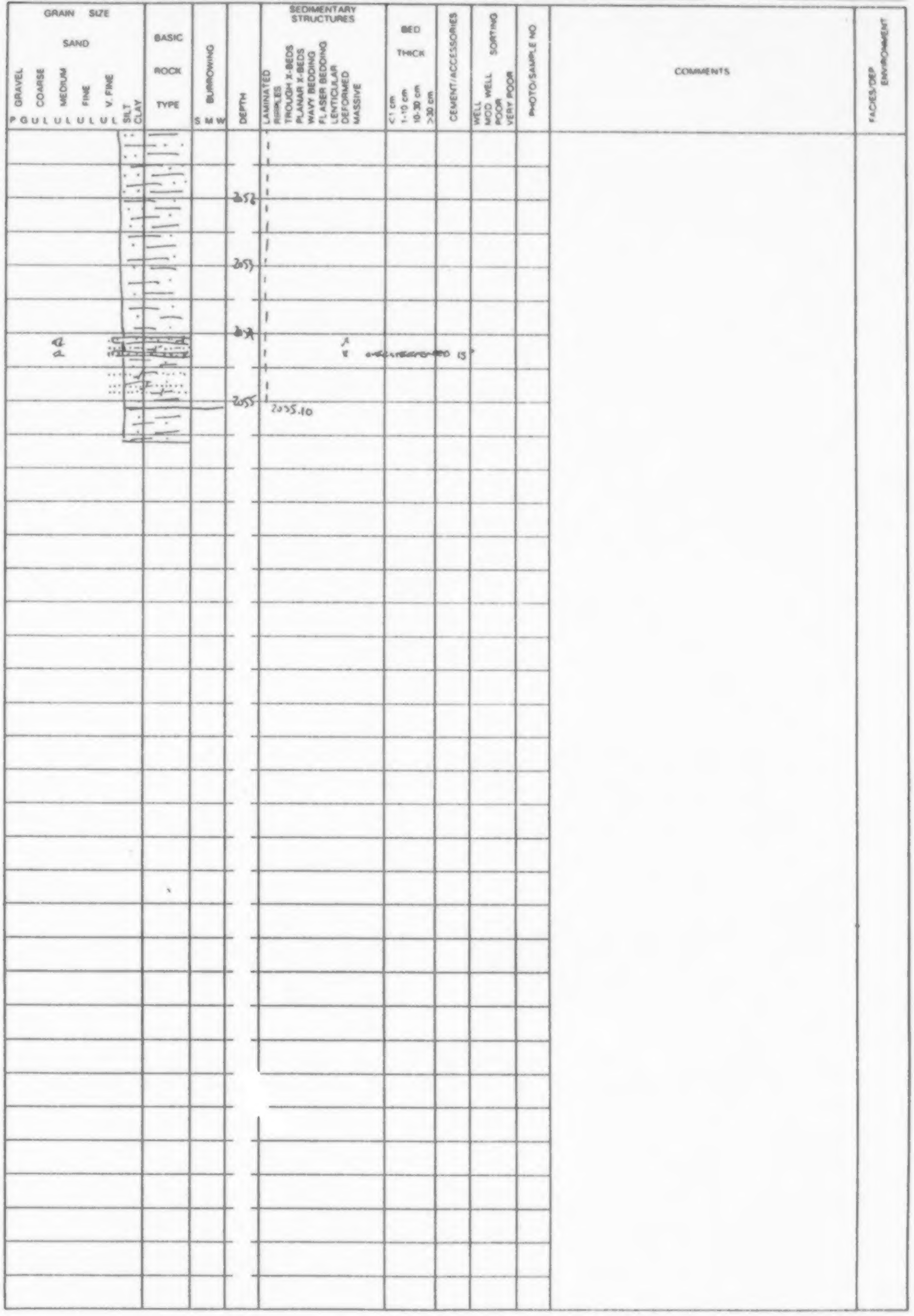
FORMATION:

DATE:

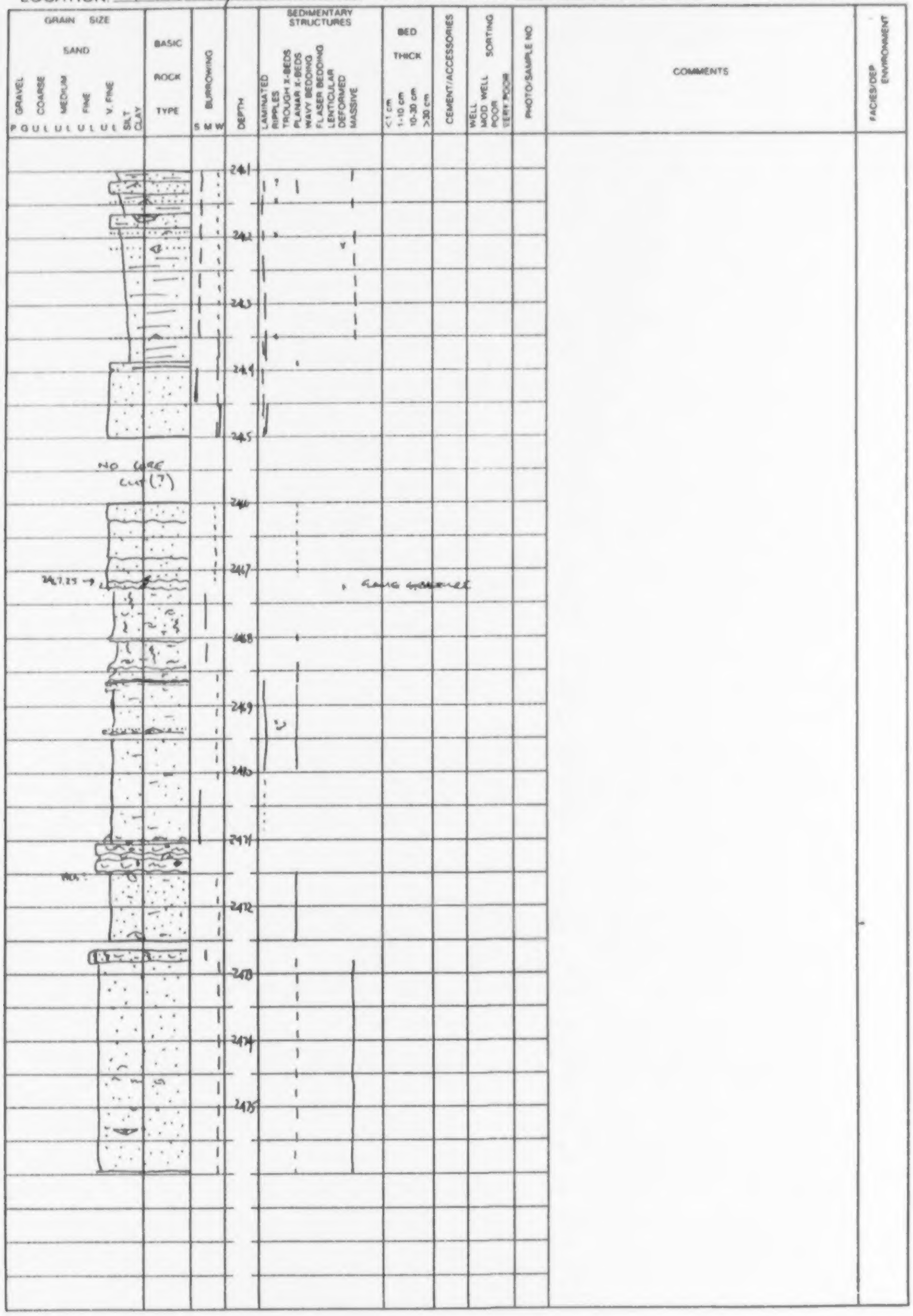
LOCATION: 8-18-80-17 /W6

CORE INTERVAL:

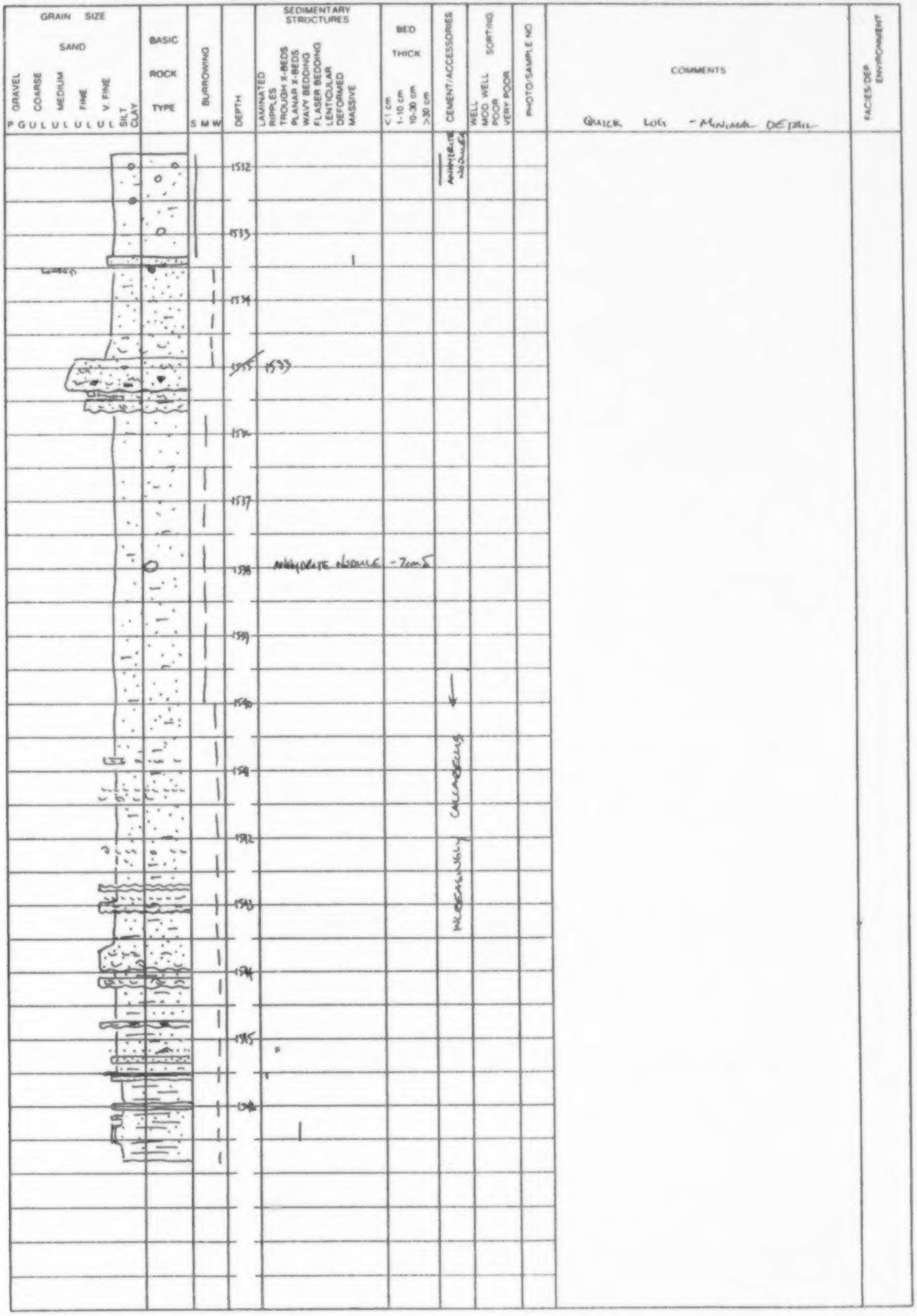
KB:


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP ENVIRONMENT
2052
2053
2054
2055
oversteepened 15°
2035.10

WELL NAME: Esso et al. Grandbirch 8-9
FORMATION: Doig
DATE: June 20th/94
LOCATION: 8-9-90-21/W6
CORE INTERVAL: 2461 - 2475.2
KB: 945.7


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP ENVIRONMENT
2461
2462
2463
2464
2465
NO CORE CUT (?)
2466
2467
2467.25 →
2468
2469
2470
2471
2472
2473
2474
2475

WELL NAME: Dome W. Boundary 11-34
FORMATION: Doig
DATE: June 21/94
LOCATION: 11-34-84-15/W6
CORE INTERVAL: 1529.8 ~~1534.8~~ - 1544.9 ~~154[illegible].8~~
KB:


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP ENVIRONMENT
Quick Log - Minimal Detail
1532
1533
1534
~~1535~~ 1533
1536
1537
1538
1539
1540
1541
1542
1543
1544
1545
1546
Anhydrite nodules
Anhydrite nodule - 7cm
Increasingly calcareous

WELL NAME: Total Bear Flat 12-24

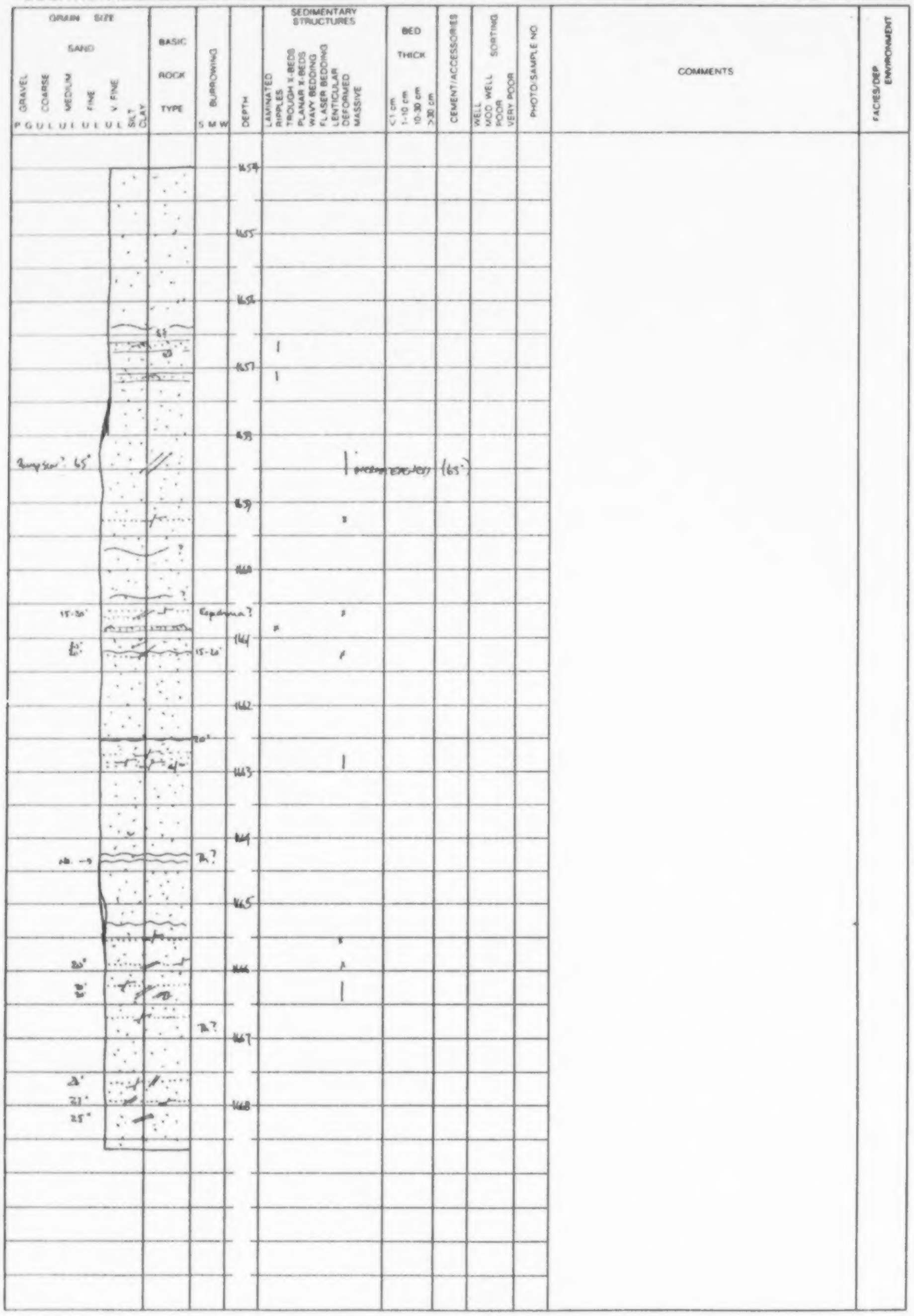
FORMATION: Doig

DATE: June 21st, 1994

LOCATION: 12-24-84-21 / w6

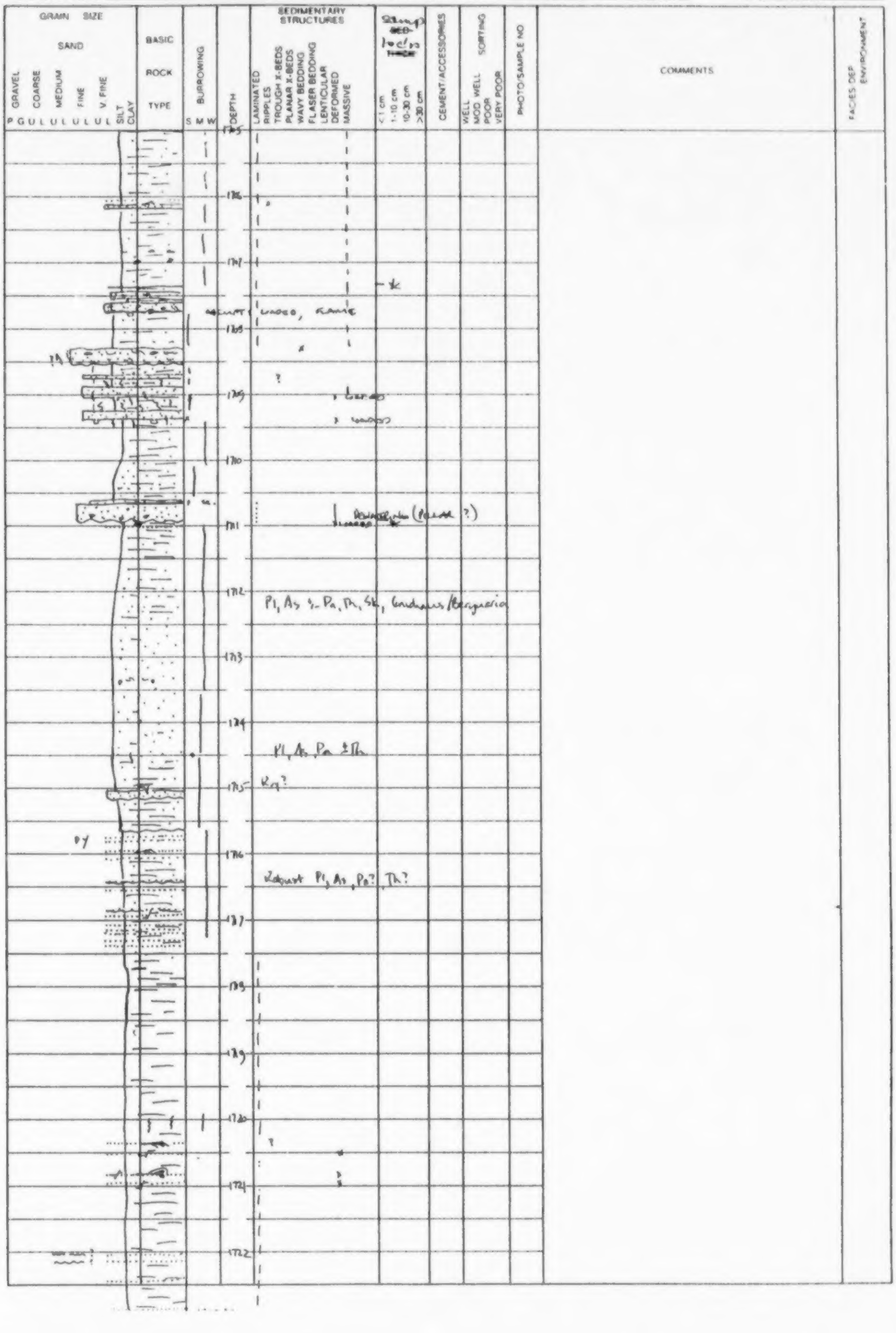
CORE INTERVAL: 1654 - 1668.65

KB:


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
P G U L U L U L U L
SILT
CLAY
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP. ENVIRONMENT
1654
1655
1656
1657
1658
1659
1660
1661
1662
1663
1664
1665
1666
1667
1668
Bumpy scr: 65°
(65°)
15-20°
15-20°
20°
Th?
Th?
20°
21°
25°

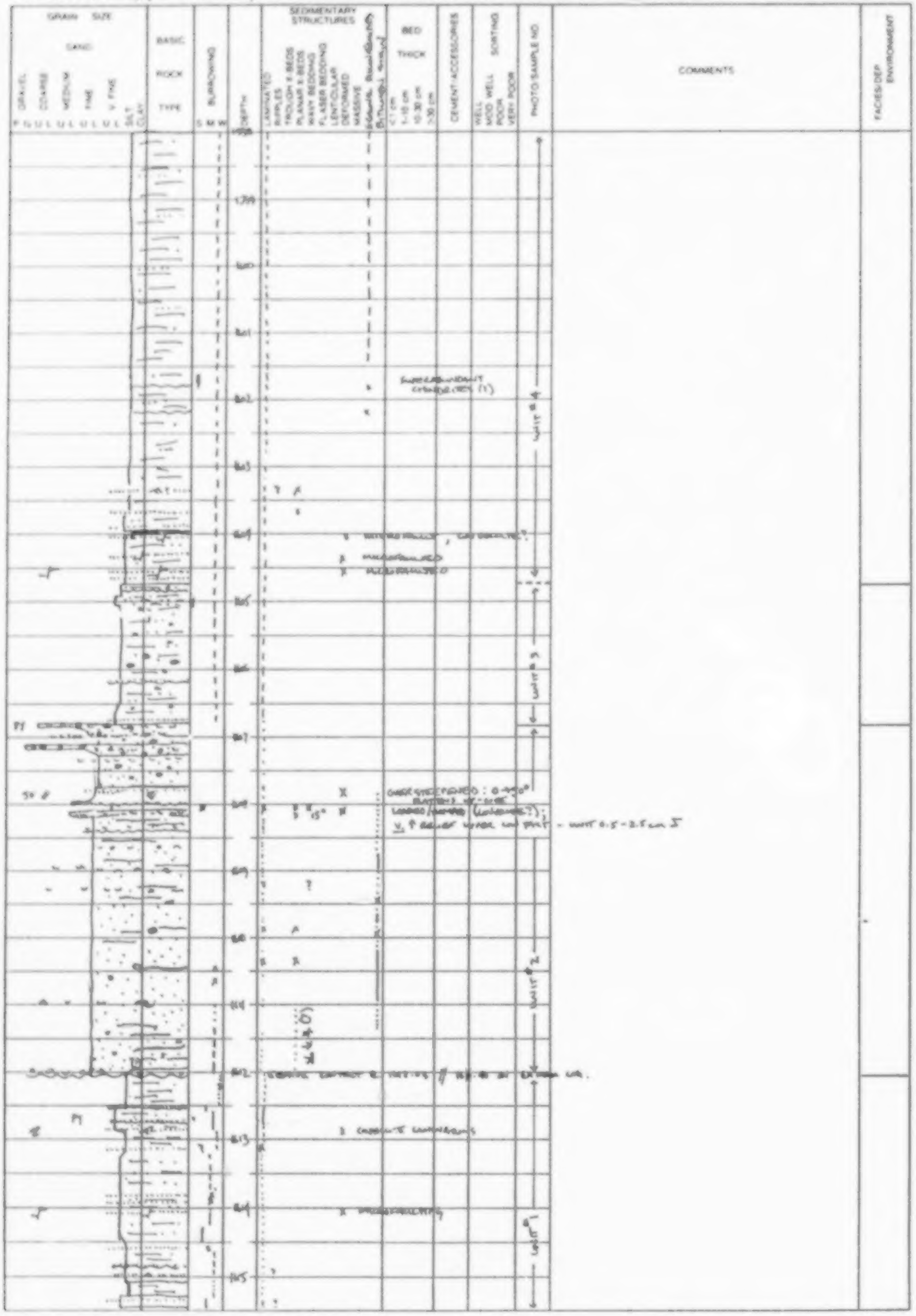
WELL NAME: Focus et al Redcreek 11-31
FORMATION: Doltz
DATE: June 22nd/94

LOCATION: 11-31-85-21 /w6
CORE INTERVAL: 1705.0 — 1722.9
KB: 8.9.3


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
Slump ~~BED~~ loc'ns ~~THICK~~
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES DEP. ENVIRONMENT
1705
1706
1707
1708
1709
1710
1711
1712
1713
1714
1715
1716
1717
1718
1719
1720
1721
1722
wavy, flame
?
, loaded
, waves
(planar ?)
Pl, As ± Pa, Th, Sk, Gordiacus/Bergaueria
Pl, As, Pa ± Th
Rq?
py
Robust Pl, As, Pa?, Th?

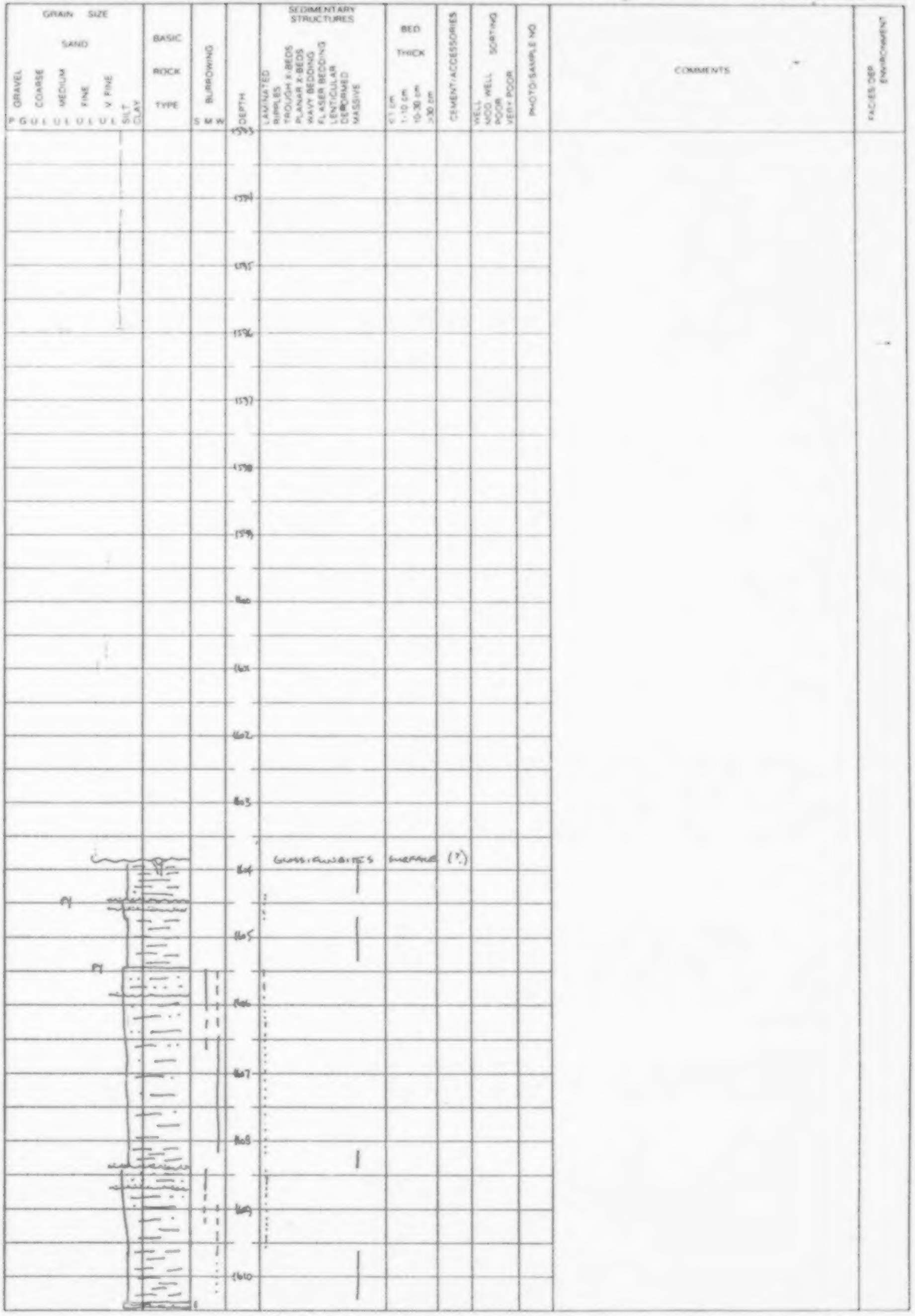
WELL NAME: Suncor et al Stoddart 6-4 FORMATION: Doig DATE: June 16,17 / 1994

LOCATION: (02) 6-4-86-20 / w6 CORE INTERVAL: 1598 - 1615.45 (measured) KB: 753m


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP. ENVIRONMENT
1598
1599
1600
1601
1602
1603
1604
1605
1606
1607
1608
1609
1610
1611
1612
1613
1614
1615
SUPERABUNDANT CHONDRITES (?)
MICROFAULTED
MICROFRACTURED
OVERSTEEPENED: 0-45°
UNIT 4
UNIT 3
UNIT 2
UNIT 1
EROSIVE CONTACT
CHONDRITE BURROWS
MICROFAULTING

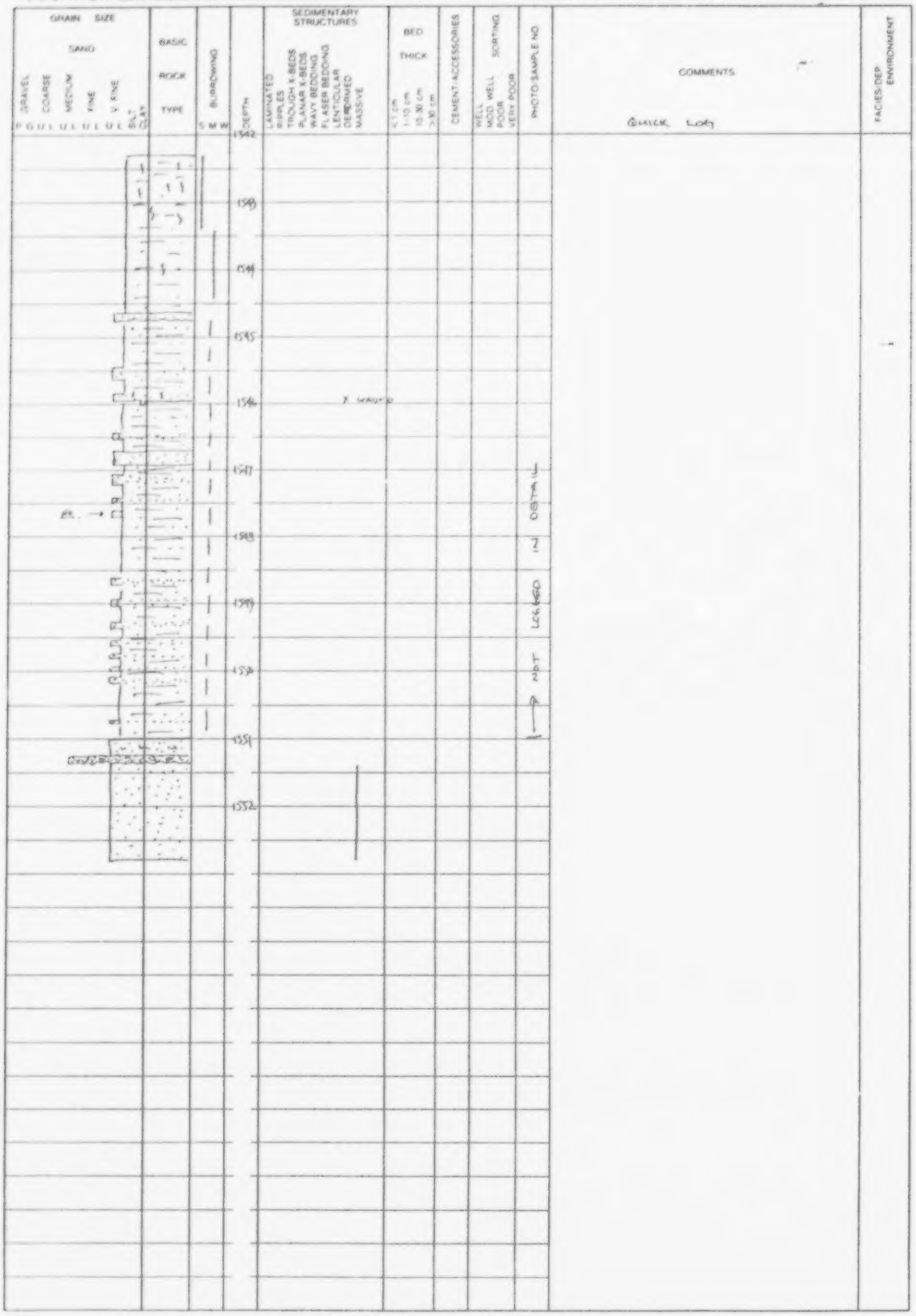
WELL NAME: Scurry ET AL W STODDART 12-4 FORMATION: Doig DATE: June 17th

LOCATION: 12-4-86-20 / w6 CORE INTERVAL: 1593.0 - 16[illegible] 1610.47 measured KB: 743.2 m


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP. ENVIRONMENT
1593
1594
1595
1596
1597
1598
1599
1600
1601
1602
1603
1604
1605
1606
1607
1608
1609
1610
GLOSSIFUNGITES SURFACE (?)
Py
Py

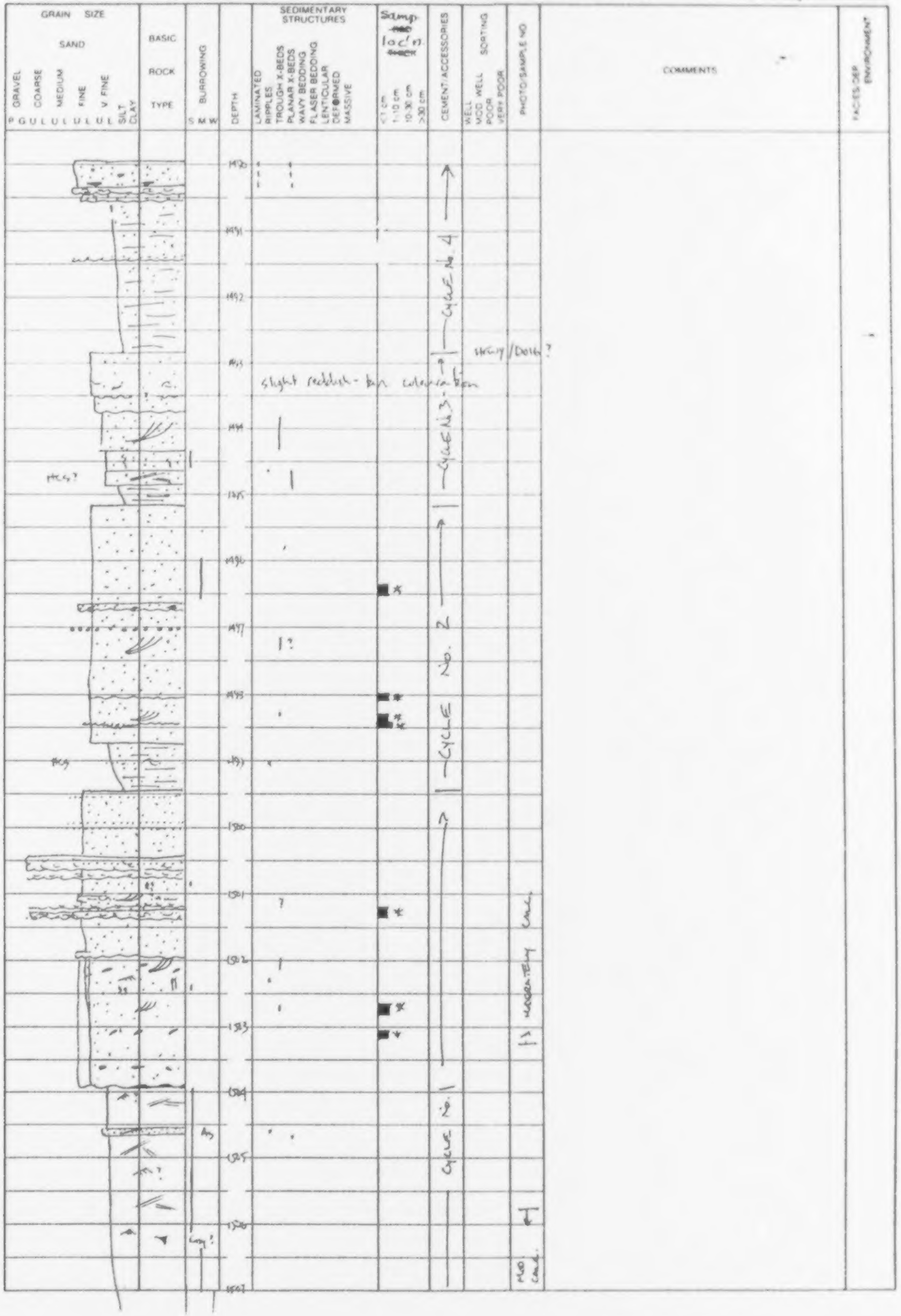
WELL NAME: MARK W. STODDART 16-15 FORMATION: Doig DATE: June 22nd/94

LOCATION: 16-15-86-20/w6 CORE INTERVAL: 1542.3 - 1552.8 KB: -


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO-SAMPLE NO.
COMMENTS
QUICK LOG
FACIES-DEP. ENVIRONMENT
1542
1543
1544
1545
1546
1547
1548
1549
1550
1551
1552
x wavy
Br. →
NOT LOGGED IN DETAIL

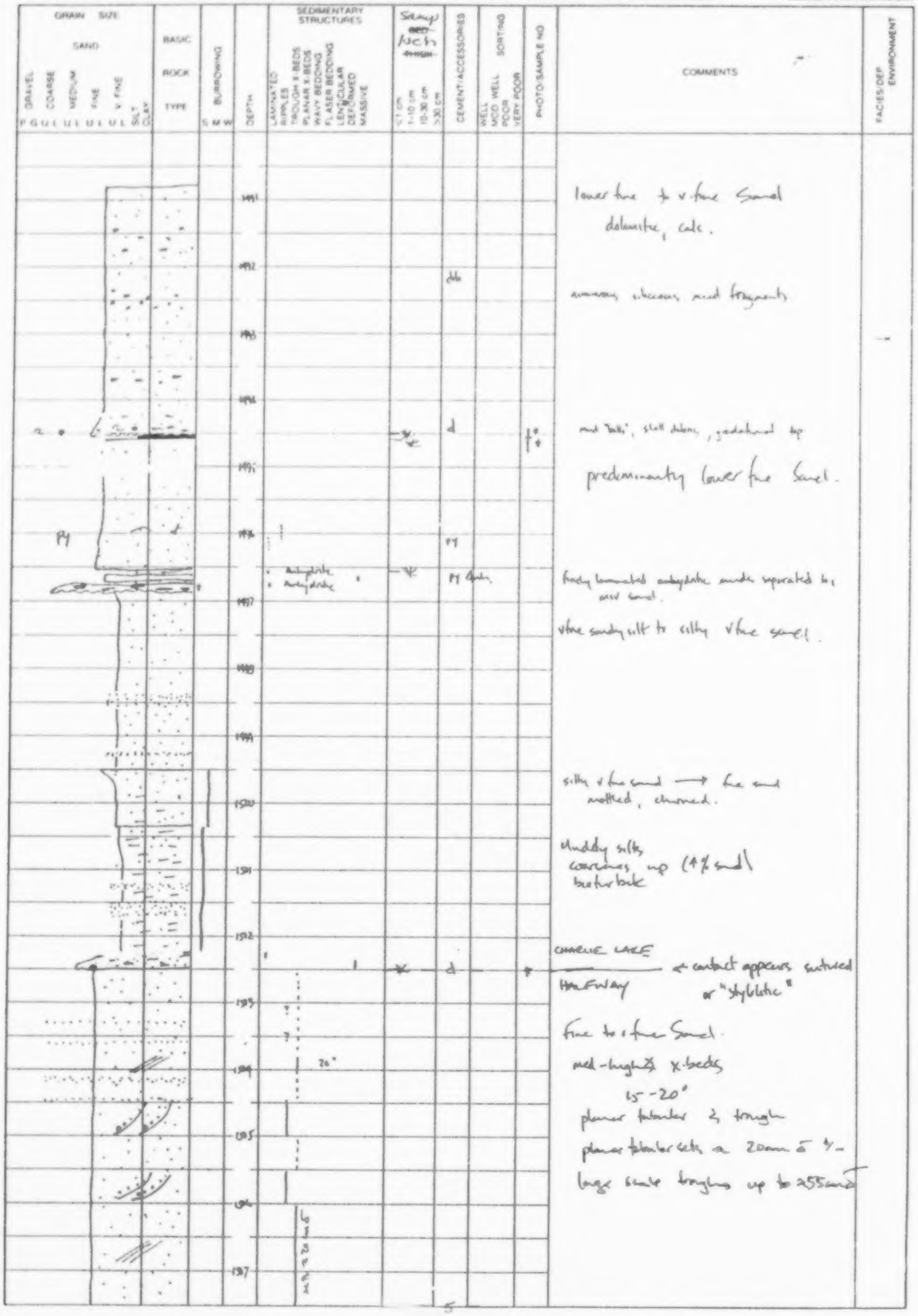
WELL NAME: Jeff Lake et al Stoddart 10-25 FORMATION: Hfwy / Doig DATE: June 22,23/94

LOCATION: 10-25-86-20 / w6 CORE INTERVAL: 1489.94 - 1507.60 KB:


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
Samp. loc'n.
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP. ENVIRONMENT
1490
1491
1492
1493
1494
1495
1496
1497
1498
1499
1500
1501
1502
1503
1504
1505
1506
1507
Cycle No. 4
Hfwy/Doig?
slight reddish-brn coloration
Cycle No. 3
Hcs?
1?
Cycle No. 2
Hcs
?
Cycle No. 1
Hcs?
Asy
Asy?
Moderately calc.
Mod calc.

1 of 3

WELL NAME: BP Murdale 10-19
FORMATION: CH.LK - HFWY - DOIG
DATE: 01/24/94
LOCATION: 10-19-87-19 /w6
CORE INTERVAL: 1490.8 - 1519.8
1509.5 - 1528.6
KB: 762.1m


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
~~BED~~ Samp
~~THICK~~ Nch
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP. ENVIRONMENT
1491
1492
1493
1494
1495
1496
1497
1498
1499
1500
1501
1502
1503
1504
1505
1506
1507
dd
d
Py
Py Anh
anhydrite
anhydrite
20°
d
5

lower fine to v.fine Sand
dolomite, calc.

numerous siliceous mud fragments

mud "balls", shell debris, gradational top

predominantly lower fine Sand.

finely laminated anhydrite nodules separated by med sand.

vfine sandy silt to silty vfine sand.

silty v fine sand ⟶ fine sand
mottled, churned.

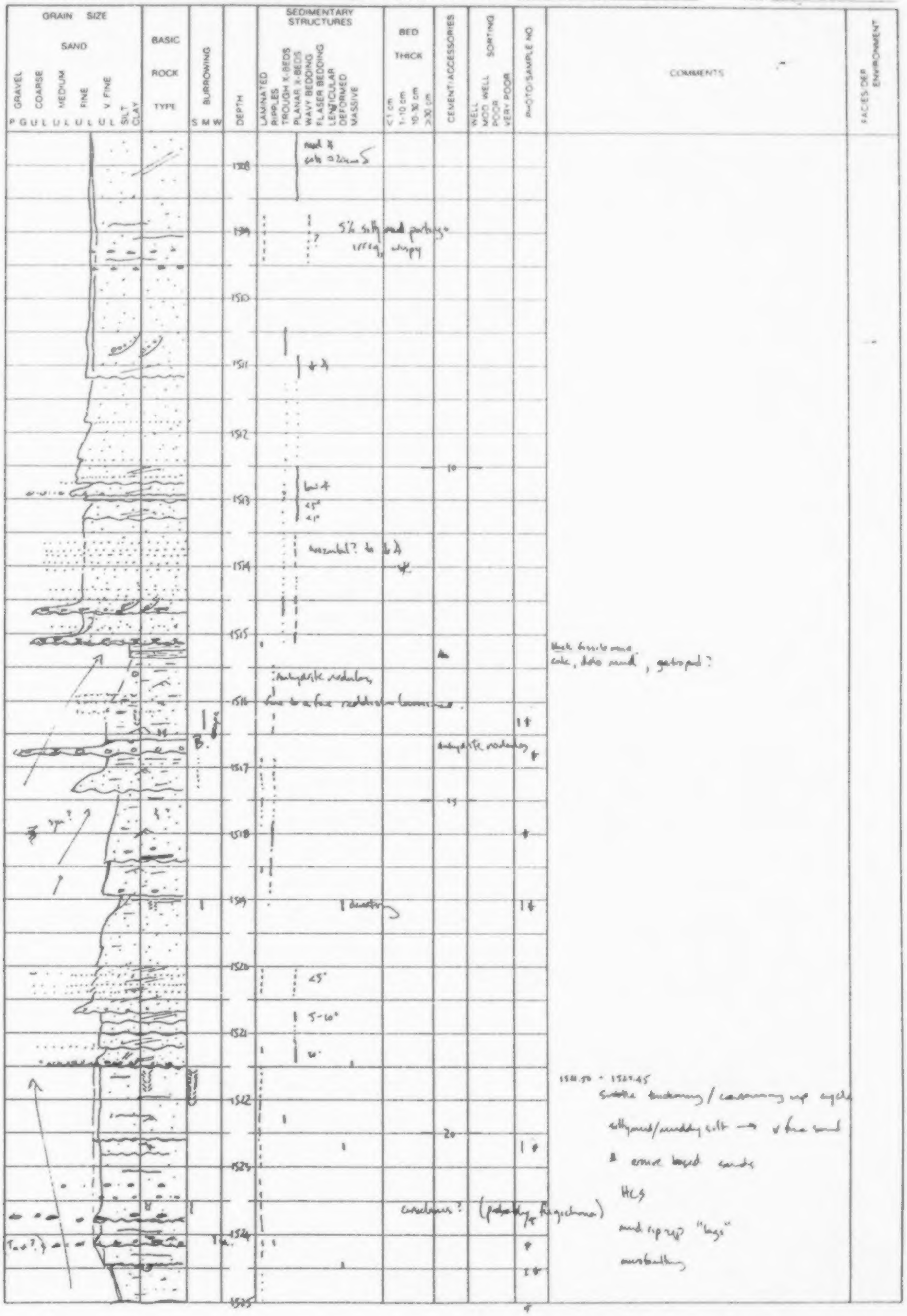
Muddy silts
coarsens up (4% sand)
bioturbate

CHARLIE LAKE
← contact appears sutured or "stylolitic"
HALFWAY

Fine to v fine Sand.
med-high∠ x-beds
15-20°
planar tabular & trough
planar tabular sets ≈ 20cm 5 ½-
large scale troughs up to 255cm

2 of 3

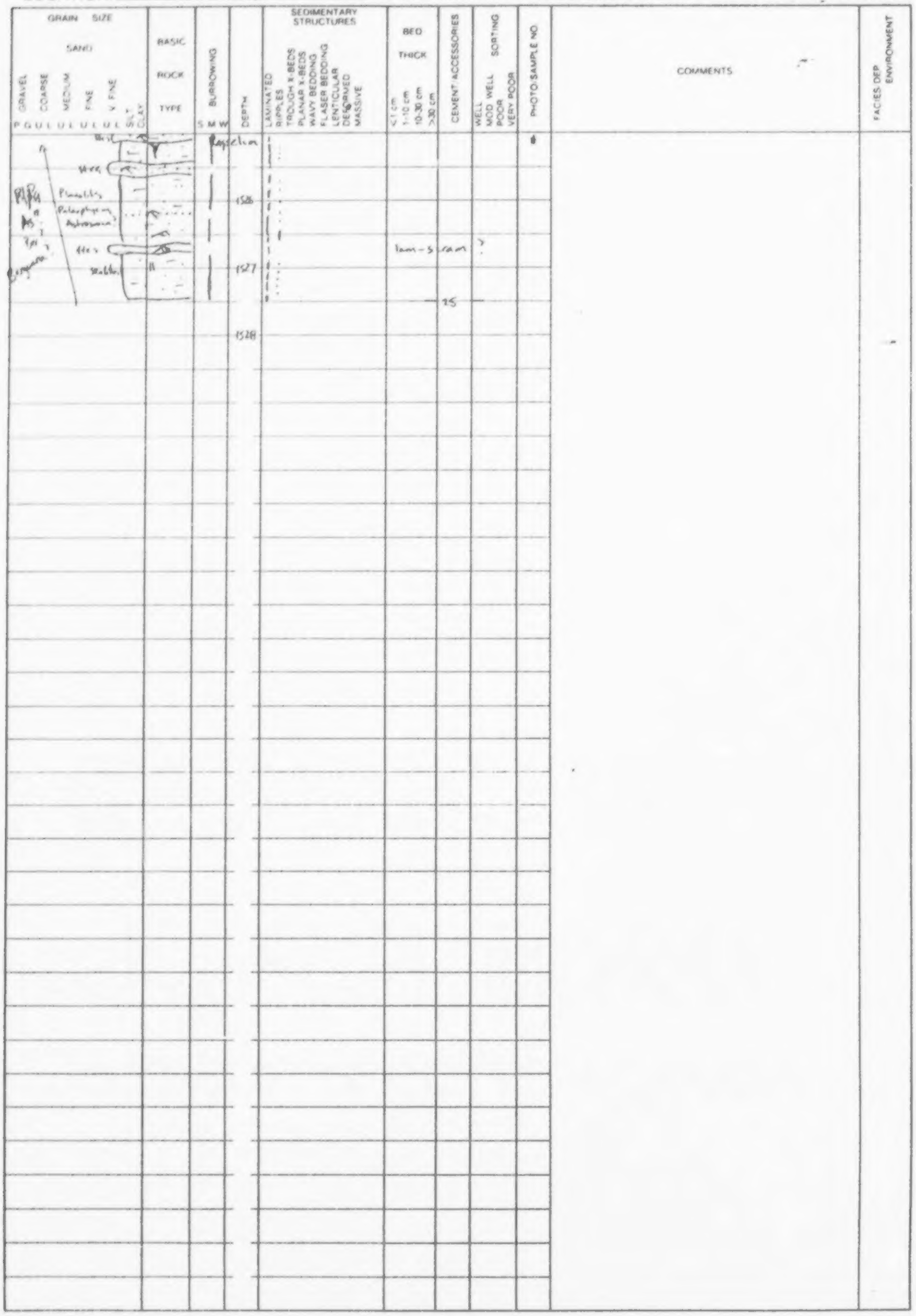
WELL NAME: BP Murdale 10-19
FORMATION: Ch.Lk. - HFWY - Dolo
DATE: 01/24/94
LOCATION: 10-19-87-19 W6
CORE INTERVAL: 1490.9 - 1509.9
1509.9 - 1528.6
KB: 762 m


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP ENVIRONMENT
1508
1509
1510
1511
1512
1513
1514
1515
1516
1517
1518
1519
1520
1521
1522
1523
1524
1525
mud & calc ≈2 cm S
5% silty mud partings
irreg, wispy
↓ ∠
low ∠
<5°
<1°
horizontal? to ↓∠
anhydrite nodules
fine to a few nodular laminae
anhydrite nodules
10
15
20
B.
Sp?
1 burrow
<5°
5-10°
10°
Ta?
Ta
caliches? (probably Rhizochnus)

black fossils ...
calc, dolo mud, gastropod?

1511.50 - 1527.45
Subtle thickening / coarsening up cycle
siltymud/muddy silt → v fine sand
& erosive based sands
HCS
mud rip up "lags"
amalgamation

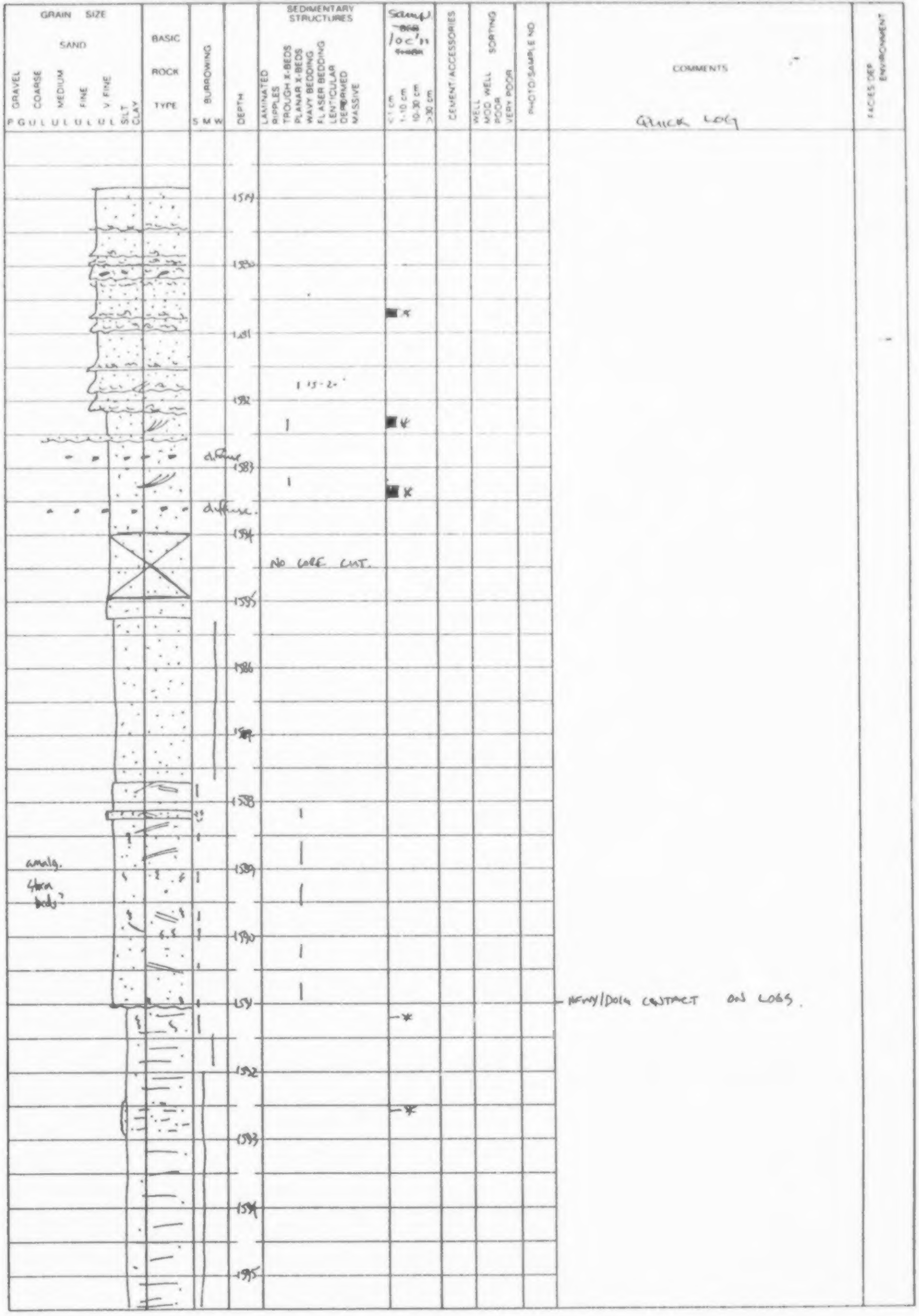
WELL NAME: BP Murdale 10-19
FORMATION: Chlk - Hfwy - Doig
DATE: 01/24/94
LOCATION: 10-19-87-19/w6
CORE INTERVAL: 1490.8 - 1509.9 / 1509.8 - 1528.6
KB: 762.1 m


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO.
COMMENTS
FACIES DEP. ENVIRONMENT
Reg. sl. m
Planolites
Palaeophycus
Asterosoma?
Pl
As
Tei
1526
1527
1528
lam-s ram
?
25
stable

p. 1 of 2

WELL NAME: HUBER W. STODDART 6-22 FORMATION: Halfway/Doig DATE: June 23/94

LOCATION: 6-22-79-20 /W6 CORE INTERVAL: 1578.86 - 1584.0
1584.96 - 1597.36 KB:


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
Scale ~~BED~~ loc'n ~~THICK~~
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
QUICK LOG
FACIES DEP. ENVIRONMENT
1579
1580
1581
1582
1583
1584
1585
1586
1587
1588
1589
1590
1591
1592
1593
1594
1595
1 15-2
diffuse
diffuse.
NO CORE CUT.
amalg.
storm
beds?
HFWY/DOIG CONTACT ON LOGS.

P-42

WELL NAME:

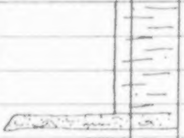
FORMATION:

DATE:

LOCATION: 6-22-37-20 /w6

CORE INTERVAL:

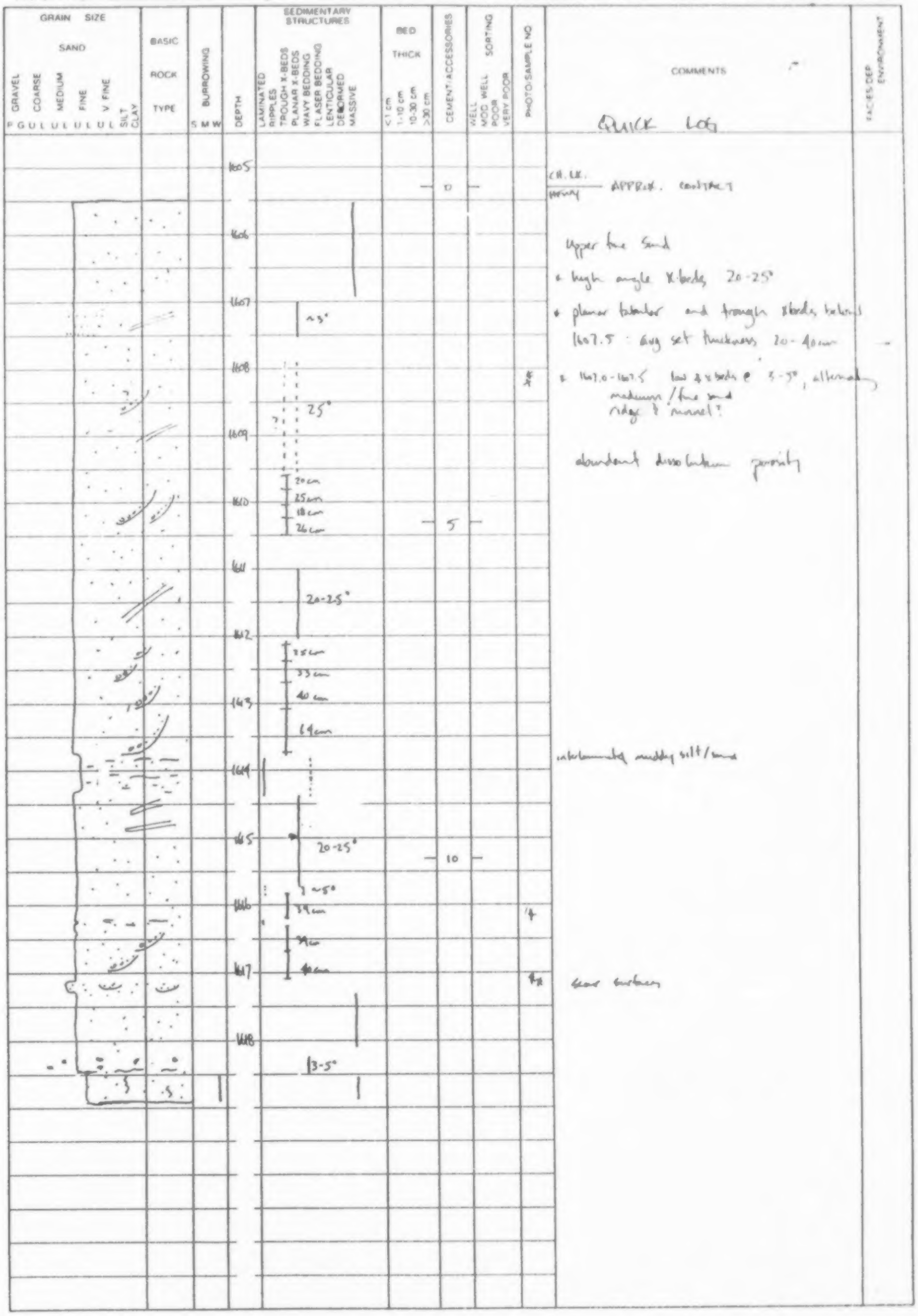
KB:



| GRAIN SIZE<br>GRAVEL P · SAND: COARSE U L · MEDIUM U L · FINE U L · V FINE U L · SILT · CLAY | BASIC ROCK TYPE | BURROWING<br>S M W | DEPTH | SEDIMENTARY STRUCTURES<br>LAMINATED · RIPPLES · TROUGH X-BEDS · PLANAR X-BEDS · WAVY BEDDING · FLASER BEDDING · LENTICULAR · DEFORMED · MASSIVE | BED THICK<br><1 cm · 1-10 cm · 10-30 cm · >30 cm | CEMENT ACCESSORIES | SORTING<br>WELL · MOD WELL · POOR · VERY POOR | PHOTO SAMPLE NO | COMMENTS | FACIES/DEP ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | 1593 |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | 1597 |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | 1595 |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | 1599 |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | 1601 |  |  |  |  |  |  |  |

WELL NAME: Diasham w. Stoddart A6-26 FORMATION: HFWY DATE: 02/02/94

LOCATION: A6-26-87-21/w6 CORE INTERVAL: 1605.5-1618.8 KB: 350.7


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP. ENVIRONMENT
1605
1606
1607
1608
1609
1610
1611
1612
1613
1614
1615
1616
1617
1618
~3°
25°
20 cm
25 cm
18 cm
26 cm
20-25°
35 cm
33 cm
40 cm
64 cm
20-25°
~5°
39 cm
39 cm
40 cm
3-5°
0
5
10

QUICK LOG

CH. LK.
HFWY APPROX. CONTACT

Upper fine Sand

- high angle X-beds 20-25°
- planar tabular and trough X-beds below 1607.5 : avg set thickness 20-40 cm
- 1607.0-1607.5 low ∠ x-beds @ 3-5°, alternating medium / fine sand ridge & runnel?

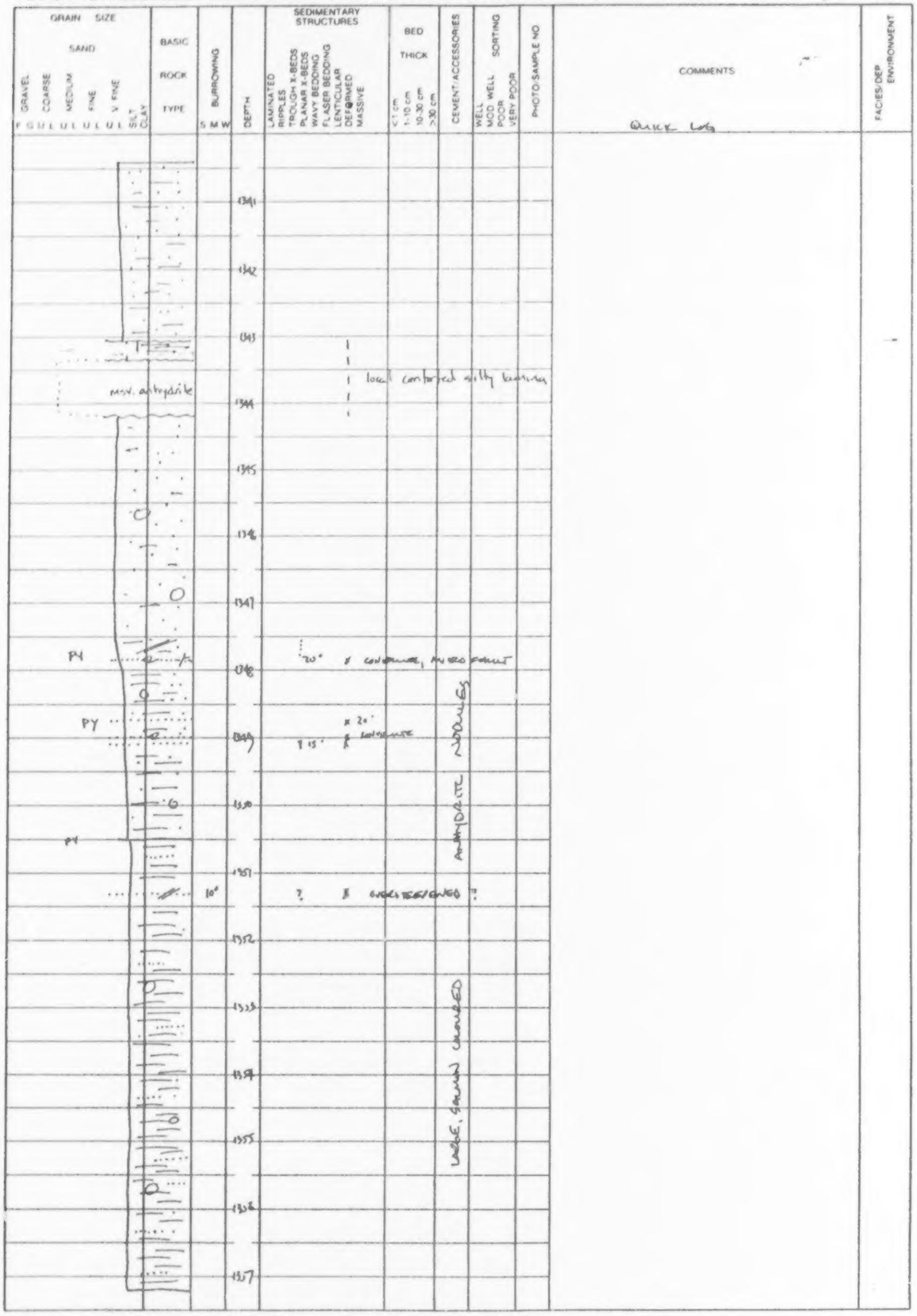
abundant dissolution porosity

interlaminated muddy silt / sand

scour surfaces

WELL NAME: ATLANTIS ET AL. BOUNDARY 6-3 FORMATION: A.Mer – Dug DATE: June 23/94

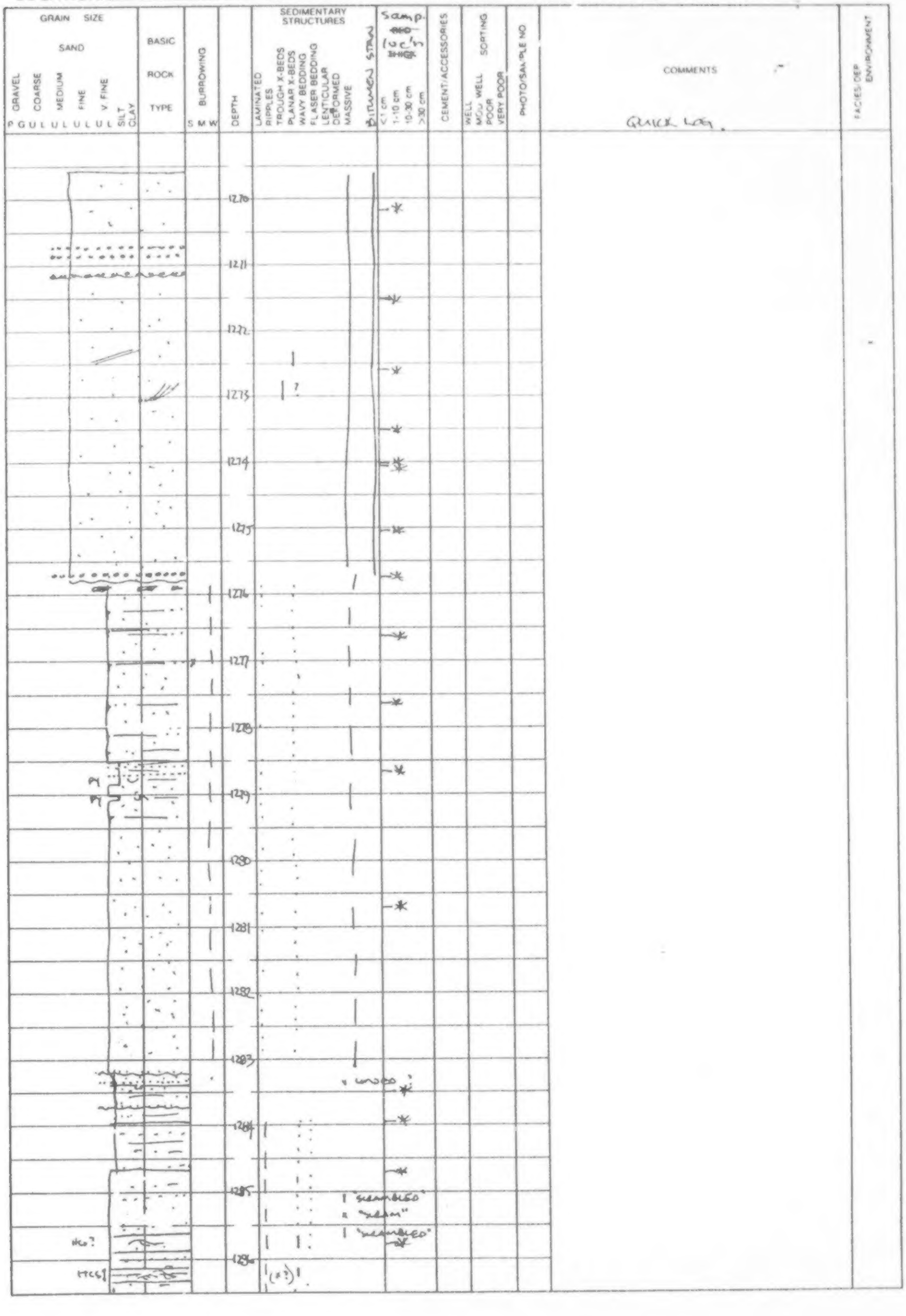
LOCATION: 6-3-88-14 /w6 CORE INTERVAL: 1340.4 - 1357.2 KB: -


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
F U L U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP ENVIRONMENT
QUICK LOG
1341
1342
1343
msv. anhydrite
local contorted silty laminae
1344
1345
1346
1347
PY
20°
contorted, micro fault
1348
PY
20°
convolute
15°
1349
ANHYDRITE NODULES
1350
PY
1351
10°
?
OVERSTEEPENED ?
1352
1353
1354
1355
LARGE, SALMON COLOURED
1356
1357

P.1 of 2

WELL NAME: TALISMAN et al RIGEL 9-19 FORMATION: HFWY / DOIG DATE June 24 / 94

LOCATION: 9-19-88-16 / W6 CORE INTERVAL: 1269.6 - 1297.99 KB:


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BITUMEN STAIN
Samp. ~~BED~~ loc'n ~~THICK~~
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD. WELL
POOR
VERY POOR
PHOTO/SAMPLE NO.
COMMENTS
QUICK LOG.
FACIES/DEP. ENVIRONMENT
1270
1271
1272
1273
?
1274
1275
1276
1277
1278
1279
1280
1281
1282
1283
WOOD
1284
1285
"SCRAMBLED"
"SEAM"
"SCRAMBLED"
HCS?
1286
HCS]
(x?)

p. 2 of 2

WELL NAME:

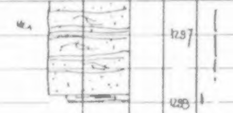
FORMATION:

DATE:

LOCATION: 9-19-89-16 /w6

CORE INTERVAL:

KB:

| GRAIN SIZE<br>SAND<br>GRAVEL P G · COARSE U L · MEDIUM U L · FINE U L · V FINE U L · SILT · CLAY | BASIC ROCK TYPE | BURROWING<br>S M W | DEPTH | SEDIMENTARY STRUCTURES<br>LAMINATED<br>RIPPLES<br>TROUGH X-BEDS<br>PLANAR X-BEDS<br>WAVY BEDDING<br>FLASER BEDDING<br>LENTICULAR<br>DEFORMED<br>MASSIVE | BED THICK<br><1 cm<br>1-10 cm<br>10-30 cm<br>>30 cm | CEMENT/ACCESSORIES | SORTING<br>WELL<br>MOD WELL<br>POOR<br>VERY POOR | PHOTO/SAMPLE NO | COMMENTS | FACIES/DEP ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | 1297<br>1298 |  |  |  |  |  |  |  |

WELL NAME: Ryerson Murphy Brusk 6-21-88-19

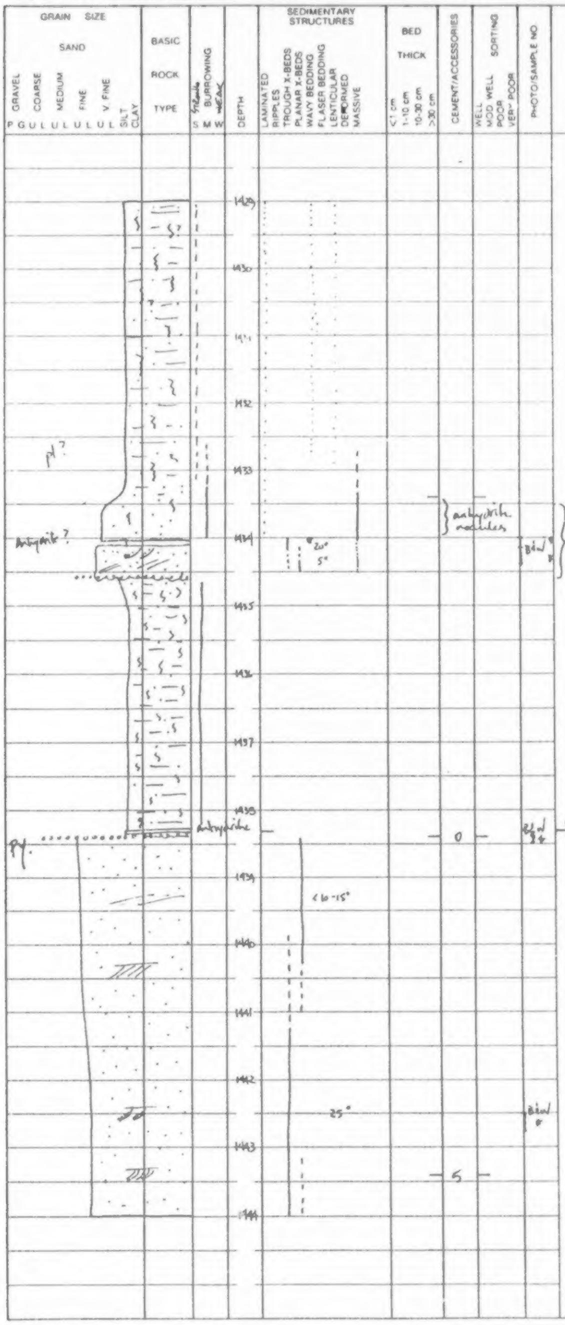
FORMATION: CHARLIE LAKE / HALFWAY

DATE: 01/24/94

LOCATION: 6-21-88-19 /w6

CORE INTERVAL: 1429.0 - 1444.0

KB: 763.0 m


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
Trace
BURROWING
Weak
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO.
1429
1430
1431
1432
1433
1434
1435
1436
1437
1438
1439
1440
1441
1442
1443
1444
pl?
Anhydrite?
Py.
anhydrite
20°
5°
<10-15°
25°
anhydrite nodules
0
5
Bdw
Bdw
Bdw

COMMENTS

Silty mud

minor admixed v fine sand

burrowed to massive

ARTEX ss. v fine sand ; gradational to anhydritic nodules

msv 'mottled'

anhydritic mud

w/ v fine sand

trough x-beds

↓ & x-beds

Silty mud.

burrowed to mottled

Pl, Th?

shaly partings

CHARLIE LAKE / HALFWAY, 2 by deposits

pyritized base

planell anhydritic silty mud

fine Sand stone

· crossbedded

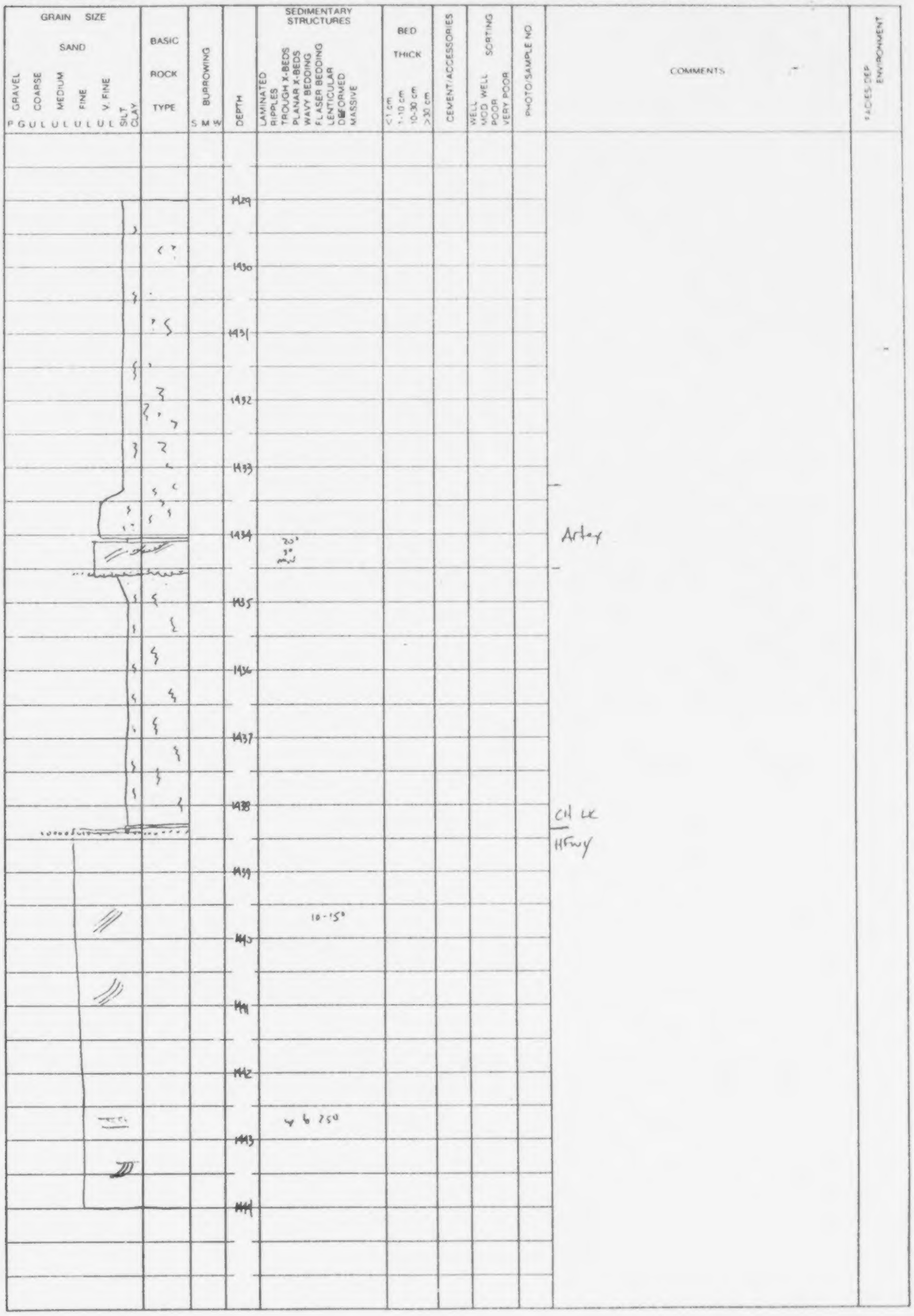
trough x bedding @ base

→ lower & planar x beds upsection

FACIES/DEP. ENVIRONMENT

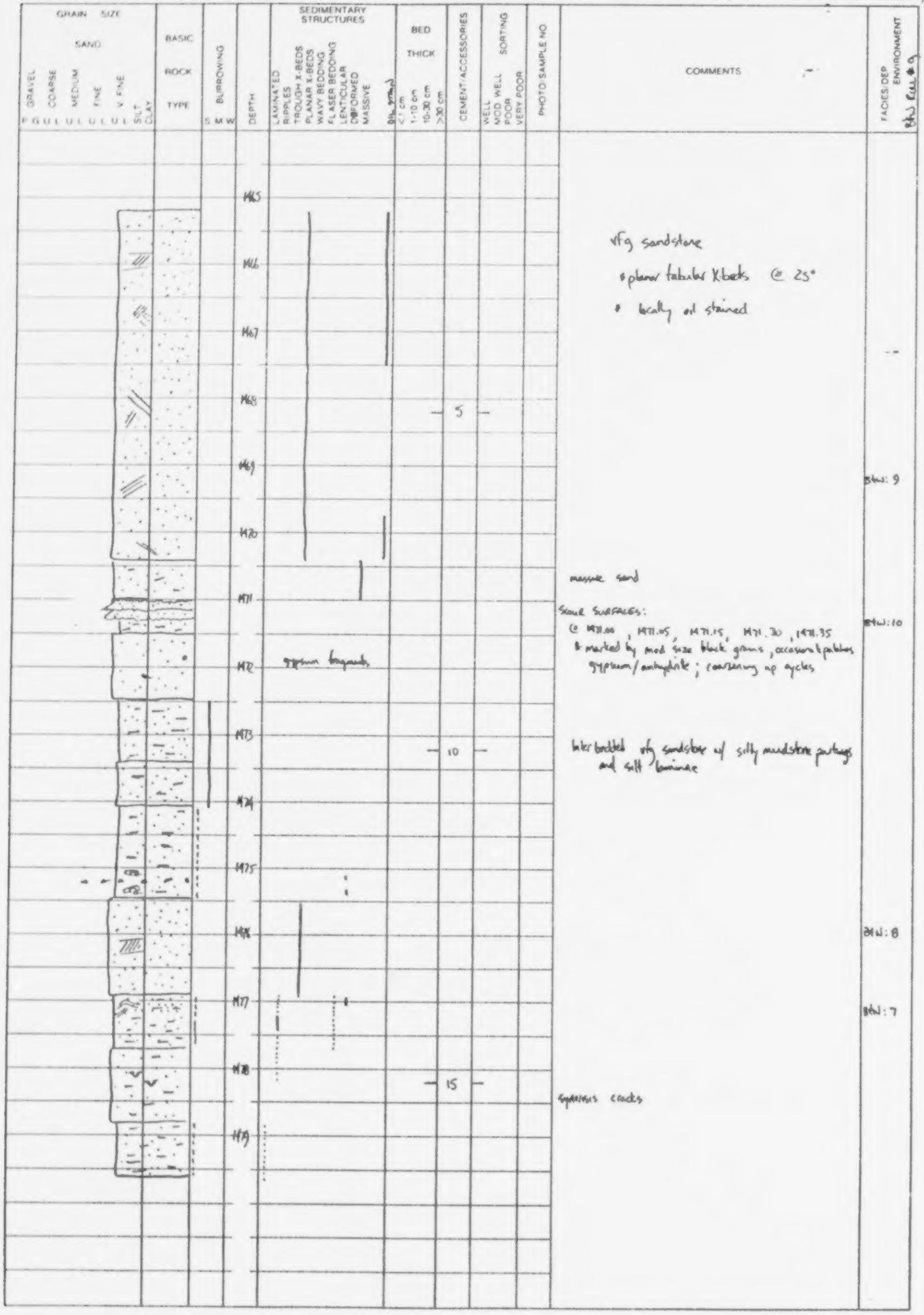
WELL NAME: Ryerson Murphy Rueck 6-21-88-19 FORMATION: CHARLIE LAKE - HFWY DATE: 01/24/94

LOCATION: 6-21-88-19 w6 CORE INTERVAL: 1429.0 - 1444.0m KB: 763.0m-


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO.
COMMENTS
FACIES/DEP. ENVIRONMENT
1429
1430
1431
1432
1433
1434
1435
1436
1437
1438
1439
1440
1441
1442
1443
1444
20°
5°
10-15°
4 6 25°
Artex
CH LK
HFwy

WELL NAME: TEXACO NFA BUICK CREEK #5 FORMATION: HALFWAY DATE: 03/03/93

LOCATION: 7-24-88-20/W6 CORE INTERVAL: 4806 ft - 4853 ft (1465.2 - 1479.6) KB: 2523 ft. (769.2 m)



GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP ENVIRONMENT
BHJ Roll #9
1465
1466
1467
1468
1469
1470
1471
1472
1473
1474
1475
1476
1477
1478
1479
5
10
15
gypsum fragments
Btw: 9
Btw: 10
Btw: 8
Btw: 7

vfg sandstone

- planar tabular X-beds @ 25°
- locally oil stained

massive sand

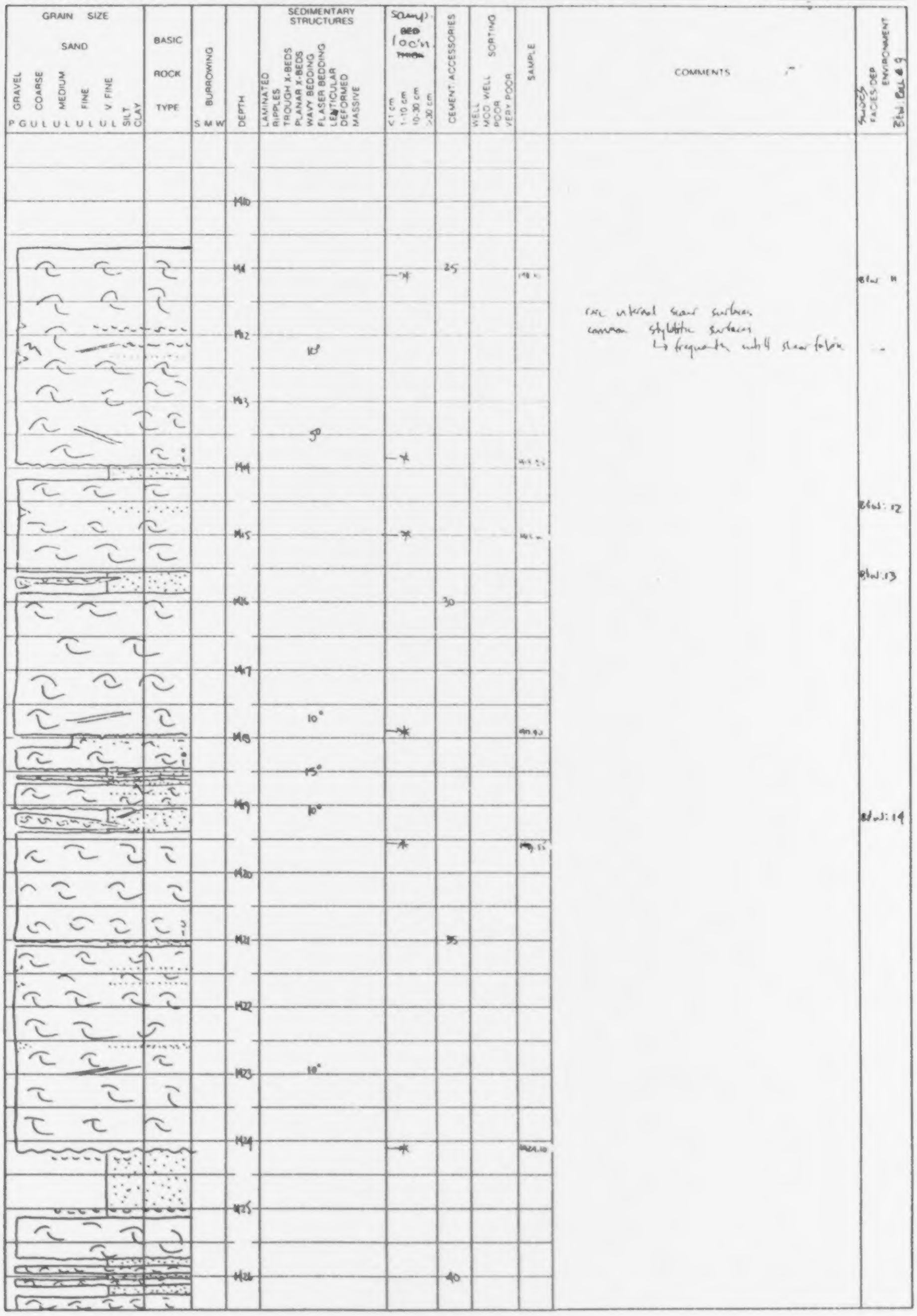
Scour SURFACES:
@ 1471.00, 1471.05, 1471.15, 1471.30, 1471.35
& marked by mod size black grains, occasional pebbles gypsum/anhydrite; coarsening up cycles

Interbedded vfg sandstone w/ silty mudstone partings and silt laminae

Syneresis cracks

1of3

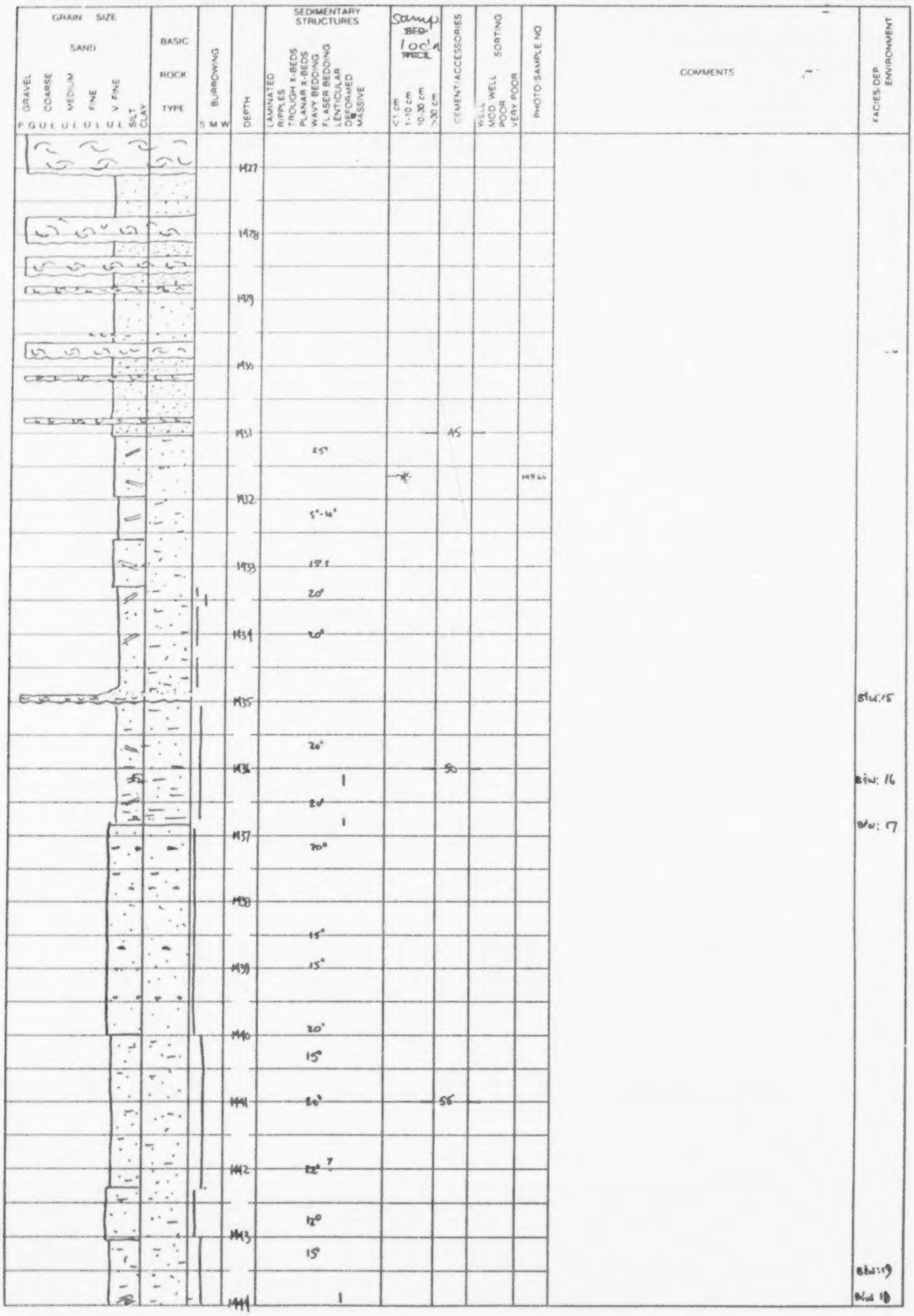
WELL NAME: Esso Buck 9-34-88-20
FORMATION: Doig
DATE: 03/04/95 June 2nd/94
LOCATION: 9-34-88-20/w6
CORE INTERVAL: 1910.7 - 1947.1
KB: 714.5


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
Samp. BED loc'n
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
SAMPLE
COMMENTS
Slides FACIES DEP ENVIRONMENT
Bkl: Box # 9
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
10°
5°
10°
15°
10°
10°
25
30
35
40
1911.10
1913.55
1915.—
1917.92
1919.55
1924.10
Blw: 11
Blw: 12
Blw: 13
Blw: 14

rare internal scour surfaces
common stylolitic surfaces
↳ frequently with scour fabric

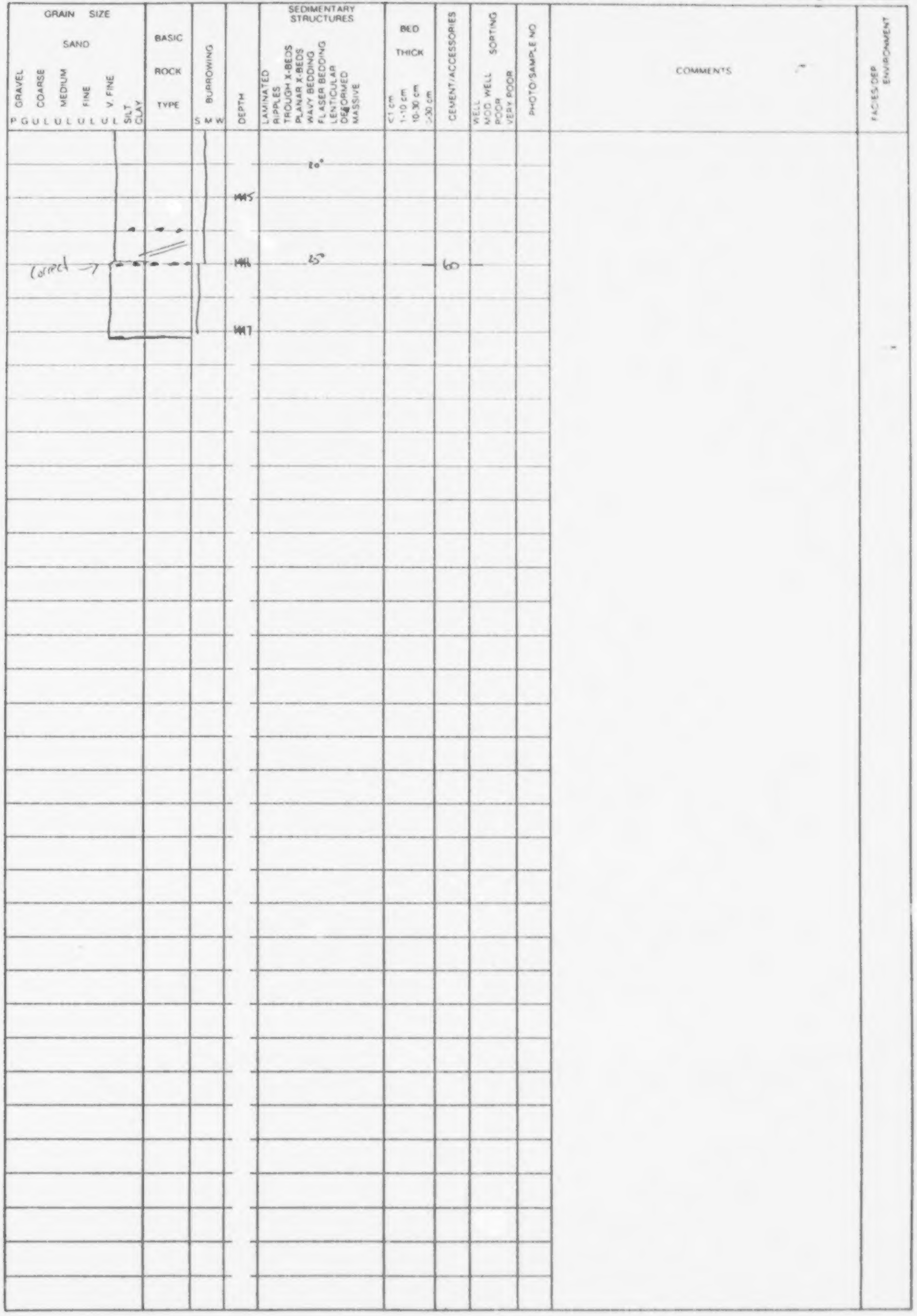
2 of 3

WELL NAME: Esso Bruce 9-34-88-20
FORMATION: Doig
DATE: 03/04/93
LOCATION: 9-34-88-20/w6
CORE INTERVAL: 1410.7 - 1447.1
KB: 714.5


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
Samp ~~BED~~ loc'n ~~THICK~~
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP ENVIRONMENT
1427
1428
1429
1430
1431
25°
45
1431.66
1432
5°-10°
1433
15°
20°
1434
20°
1435
Blw: 15
20°
1436
50
Blw: 16
20°
Blw: 17
1437
20°
1438
15°
1439
15°
20°
1440
15°
1441
20°
55
1442
22° ?
12°
1443
15°
Blw: 19
Blw 18
1444

WELL NAME: Esso Buick 9-34-88-20 FORMATION: Doig DATE: 03/04/93

LOCATION: 9-34-88-20/w6 CORE INTERVAL: 1410.7 - 1447.1 KB: 714.5 -


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD. WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP. ENVIRONMENT
20°
1445
Correct →
1446
25°
60
1447

WELL NAME: CanDel et al Farrell a-30-L

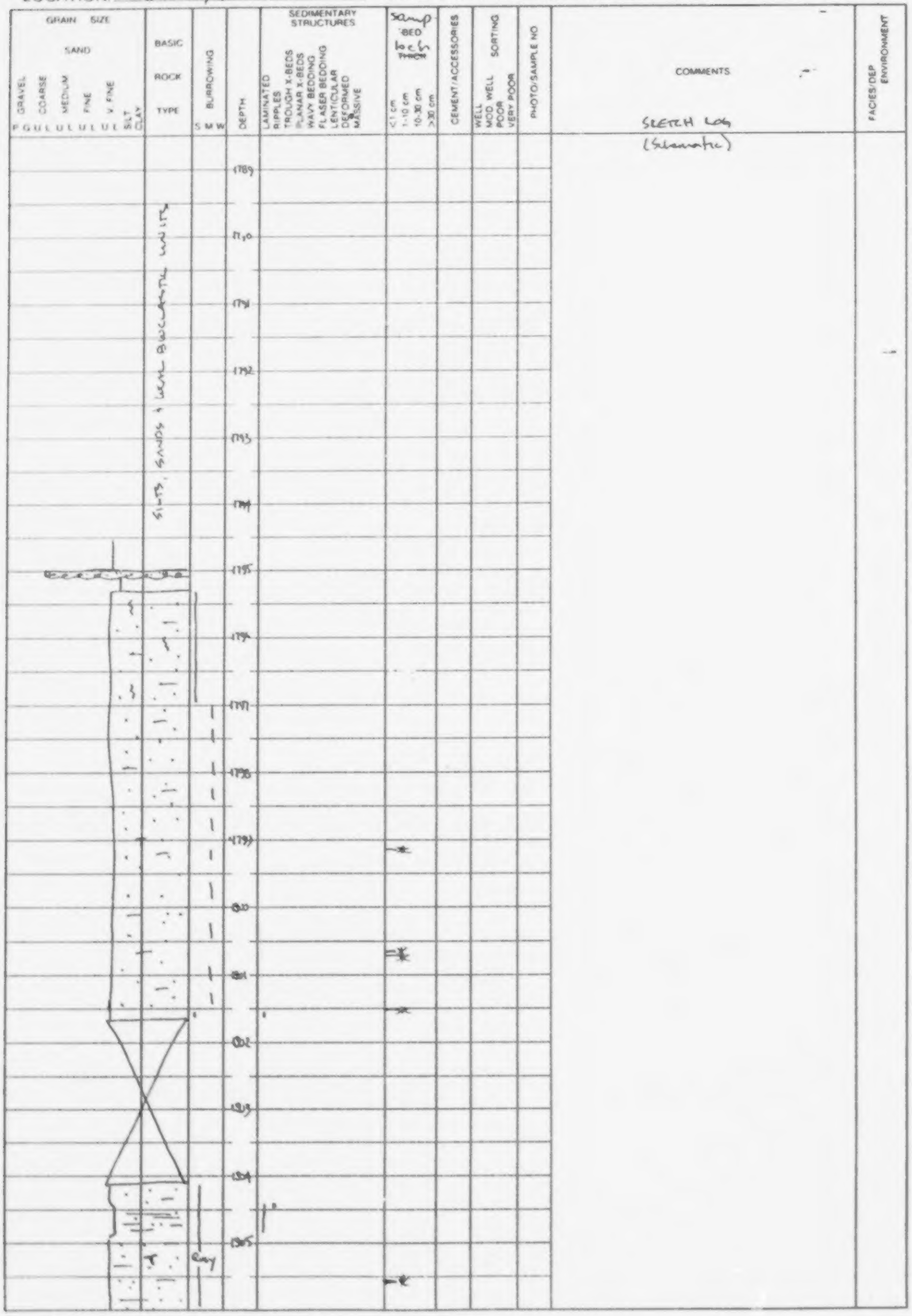
FORMATION: HFWY / Doig

DATE: June 24th

LOCATION: a-30-L / 94-A-5

CORE INTERVAL: 1798.57 - 1801.67
1909.11 - 1927.91 (')

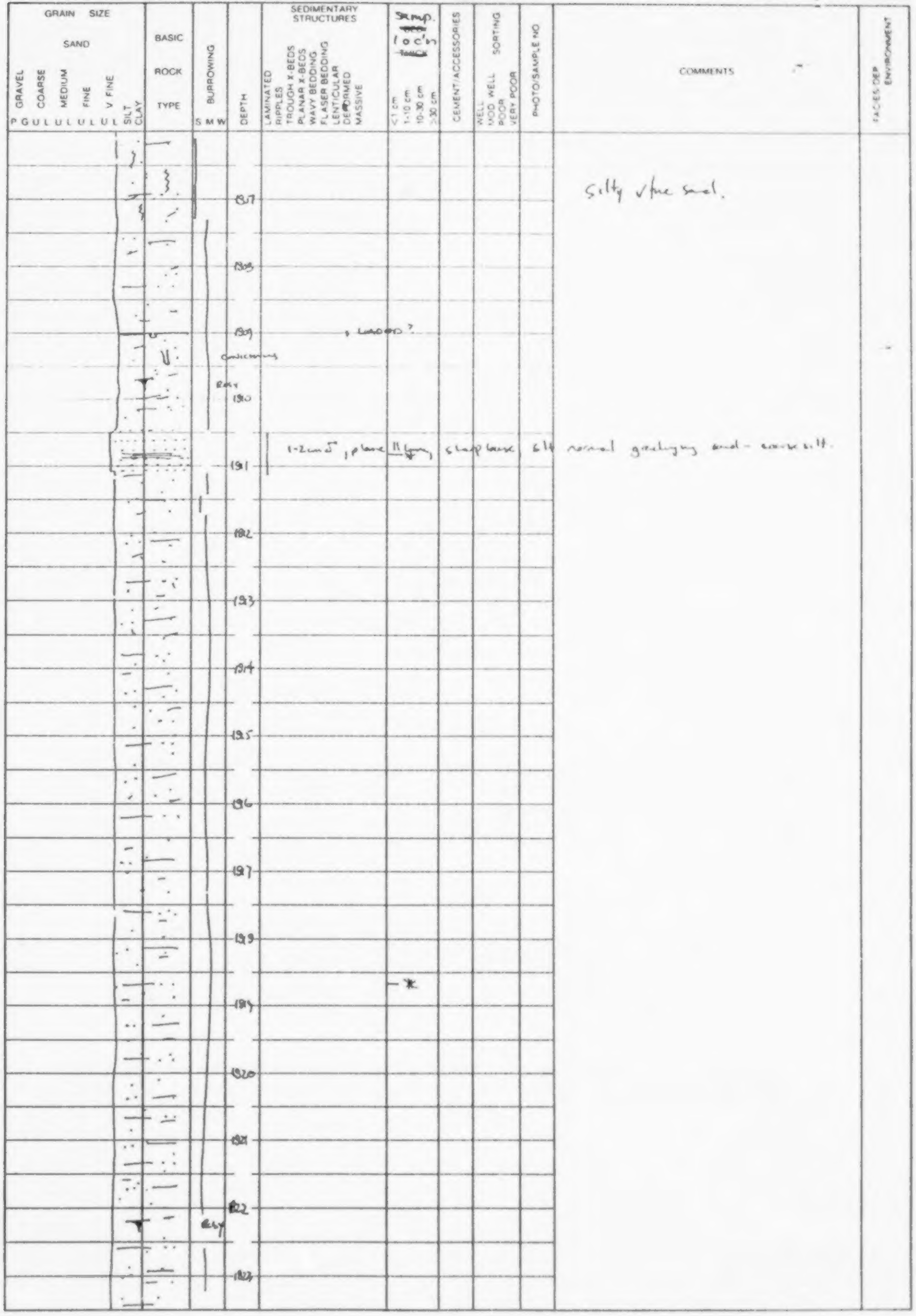
KB:


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
samp
~~BED~~
loc'n
~~THICK~~
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP ENVIRONMENT
SKETCH LOG
(Schematic)
1789
1790
1791
1792
1793
1794
1795
1796
1797
1798
1799
1800
1801
1802
1803
1804
1805
SILTS, SANDS + WEAK BIOCLASTIC UNITS
Gray

p.243

WELL NAME: ______ FORMATION: ______ DATE: ______

LOCATION: 2-30-L/94-A-5 CORE INTERVAL: ______ KB: ______

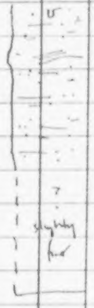

GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
Samp.
~~BED~~
loc'n
~~THICK~~
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP. ENVIRONMENT
1907
1908
1909
, LOADED?
Conichnus
Esc
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
*
1920
1921
1922
Esc
1923

Silty vfine sand.

1-2cm S', plane ‖ lam, sharp base, slt normal grading sand – coarse silt.

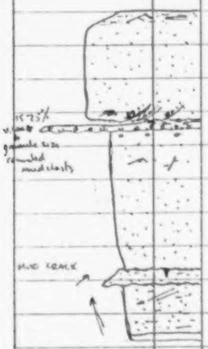
p.383

WELL NAME:
FORMATION:
DATE:
LOCATION: 7-32L / 94-4-5
CORE INTERVAL:
KB:



| GRAIN SIZE<br>GRAVEL COARSE MEDIUM FINE V FINE SILT CLAY<br>P G U L U L U L U L | BASIC ROCK TYPE | BURROWING<br>S M W | DEPTH | SEDIMENTARY STRUCTURES<br>LAMINATED RIPPLES TROUGH X-BEDS PLANAR X-BEDS WAVY BEDDING FLASER BEDDING LENTICULAR DEFORMED MASSIVE | BED THICK<br><1 cm 1-10 cm 10-30 cm >30 cm | CEMENT/ACCESSORIES | SORTING<br>WELL MOD WELL POOR VERY POOR | PHOTO/SAMPLE NO | COMMENTS | FACIES DEP ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|
| | U | cont. | coring | | | | | | | |
| | | | 1324 | 11 | | | | | | |
| | | | 1325 | | | | | | | |
| | 7 | | 1326 | | | | | | | |
| | slightly hard | | 1327 | MOST CORE REMOVED BY CLIENT | | | | | | |
| | | | 1328 | | | | | | | |

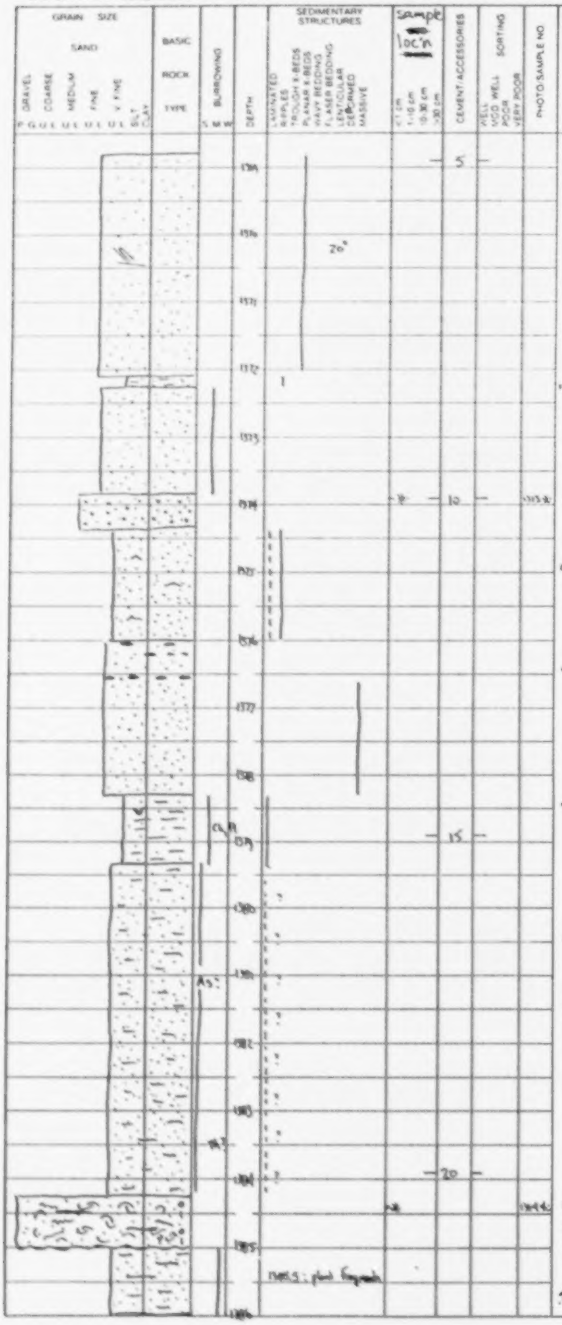
WELL NAME: Enor et al Rigel A-29-K
FORMATION: 1360.0 - 1365.6 m
DATE: 01/26/94
LOCATION: a-29-K / 94-A-10
CORE INTERVAL: CHARLIE LAKE / HFWY
KB: 724.1 m



| GRAIN SIZE<br>SAND<br>GRAVEL COARSE MEDIUM FINE V FINE SILT CLAY<br>P G U L U L U L U L | BASIC ROCK TYPE | BURROWING<br>S M W | DEPTH | SEDIMENTARY STRUCTURES<br>LAMINATED RIPPLES TROUGH X-BEDS PLANAR X-BEDS WAVY BEDDING FLASER BEDDING LENTICULAR DEFORMED MASSIVE | BED THICK<br><1 cm 1-10 cm 10-30 cm >30 cm | CEMENT/ACCESSORIES | SORTING<br>WELL MOD WELL POOR VERY POOR | PHOTO/SAMPLE NO | COMMENTS | FACIES/DEP ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1360 | \| \| | | | | | uppr fine trough x-bedded sand. | |
| | | | 1361 | | | 1% py | | | | |
| | | | | | | | | | ~15-20% v coarse to granule mud balls; laminated sand-silt<br>silty sand + vfine sand to u. vfine sand<br>coarsens up | |
| | | | 1362 | alt'n | | | | | | |
| | | | 1363 | mod appearance due to alt'n. | | | | | | |
| | | | 1364 | ? ? <5° to ll<br>l 10-15° | — | o | — | I | CHARLIE LAKE<br>——?<br>HALFWAY<br>vfine sand silt to (silty) vfine sand.<br>med X x beds?<br>(alt'n pattern) | |
| | | | 1365 | | | | | | | |

WELL NAME: Enkor Et Al Rigel 8-29-K FORMATION: ______ DATE: 03/04/93

LOCATION: 200/ a-29-K 94-A-10 CORE INTERVAL: 1368.8 - 1386.0 KB: 724.1


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
sample loc'n
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
1369
1370
20°
1371
1372
1373
1374
1373.8
5
10
15
20
1375
1376
1377
1378
1379
1380
1381
1382
1383
1384
1384.4
1385
1386
1385.9: plant fragments

COMMENTS

Routine Log

Fine sand
1368.8 - 1372.1
bitumen stain
planar-tabular X-beds @ ~ 20°

interlaminated muds/silts, weakly rippled

mottled sand
bioturbate

fine (medium) sand w/ 20% coarse sand-size grains
sub-horizontal laminations

rippled fine to v.fine sand
wave ripples?
local plane parallel lamination

massive sand, fine
local mud rip-ups to 3mm long

interlaminated mud/silt
syneresis cracks @ 1378.55
plane parallel laminations
chondrites / planolites

mostly v.fine (to fine?) sand
with sandy silt & silty mud laminations
sporadically

palaeophycus, planolites, helminthopsis (?)

1381.1 possible asterosoma
1383.5 thalassinoides burrow
(1.4cm x 0.5cm in x-section)

bioclastic conglomerate
shells up 2cm long, most few mm's
few thin shaly partings
erosive base

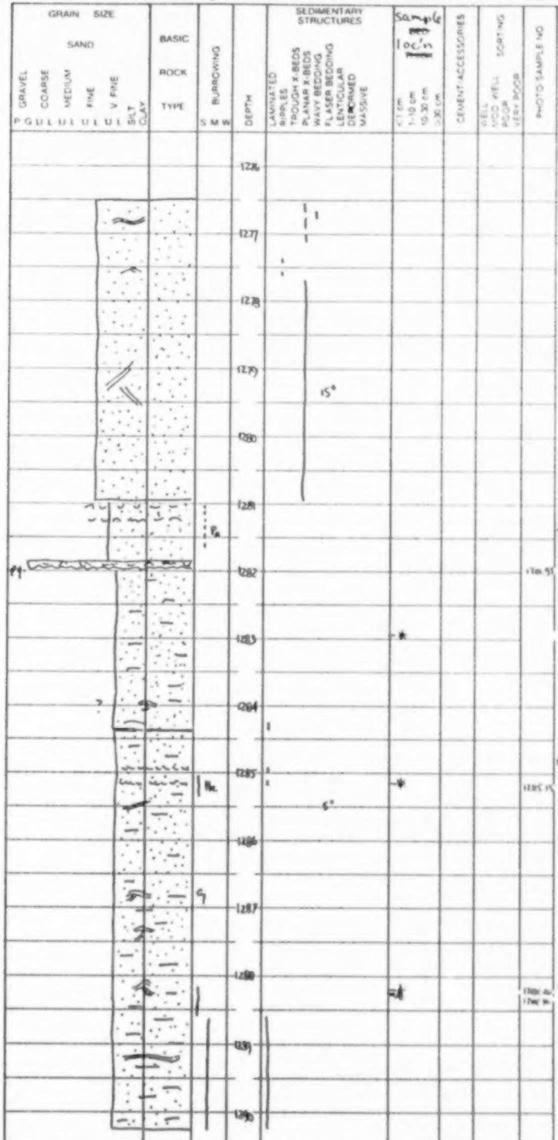
slightly finer?
more thoroughly homogenized by bioturbation

FACIES/DEP ENVIRONMENT

Pbl:20

WELL NAME: HOME ET AL. RIGEL d-87-K FORMATION: ______ DATE: 03/04/93

LOCATION: d-87-K /94-A-10 CORE INTERVAL: 1276.5 – 1290.25 KB: -


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
Sample ~~BED~~ loc'n ~~THICK~~
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD. WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
1276
1277
1278
1279
1280
1281
1282
1283
1284
1285
1286
1287
1288
1289
1290
15°
5°
py.
Pa
Hc
G
1281.95
1285.15
1288.60
1288.36

COMMENTS

FACIES DEP. ENVIRONMENT

[illegible]

v. fine to fine sandstone
* bitumen stain
* upper [illegible] almost all structures obliterated by bitumen

* planar tabular X-beds, foresets ~15°

1276.60 – 1276.75 wavy beds ?
1277.4(?) ripple crests?
1277.6 ripple crests, symmetric

v. fine sand, mod.
"white spots" → all're about circular burrows?

1281.95 bioclastic, burrowed lag; erosive base, highly pyritized

VF sand to silt
generally structureless

1285.15, 1284.95: laminated, v. fine (≤1mm) bioclastic fragments
(dolomitized)

1285.15

1285.5 ~10cm bed parallel lamination @ 5°

1286.74 – 1286.85 HCS
truncated by 2 cylindrichnus burrows at top

1287.55 HCS

1288.60 1288.60 HCS
1288.36 1288.36 – 1288.60 "white spots"

palaeophycus, planolites, helminthopsis, (chondrites?)

faint parallel undulose lamination

WELL NAME: Saye et al. Burke

FORMATION: Doig

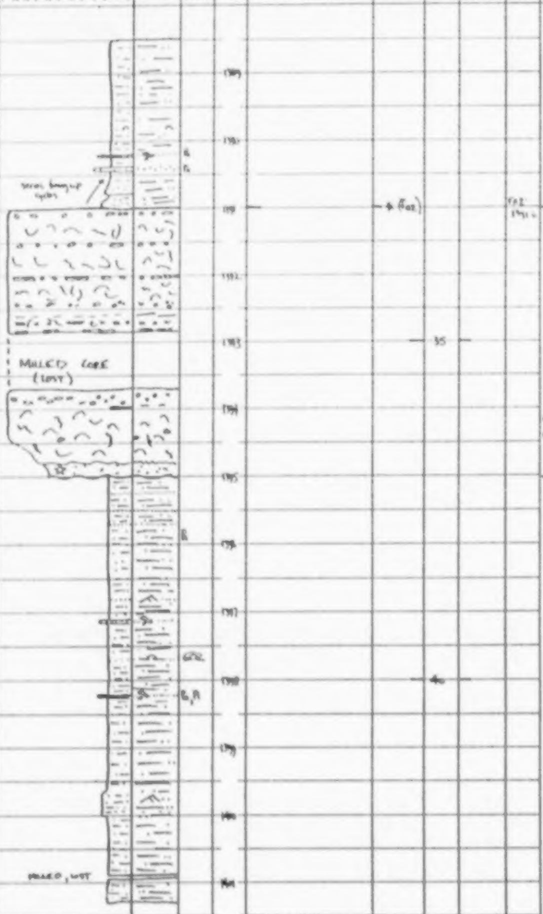
DATE: 02/22/93

LOCATION: d-36-I/94-A-11

CORE INTERVAL: 1388.5 – 1401.3 / 1388.5 – 1399.0

KB: 691.0

GRAIN SIZE — SAND: GRAVEL, COARSE, MEDIUM, FINE, V FINE, SILT, CLAY (P G U L U L U L U L) | BASIC ROCK TYPE | BURROWING (S M W) | DEPTH | SEDIMENTARY STRUCTURES: LAMINATED, RIPPLES, TROUGH X-BEDS, PLANAR X-BEDS, WAVY BEDDING, FLASER BEDDING, LENTICULAR, DEFORMED, MASSIVE | Sample loc'n (<1 cm, 1-10 cm, 10-30 cm, >30 cm) | CEMENT/ACCESSORIES | SORTING: WELL, MOD. WELL, POOR, VERY POOR | PHOTO/SAMPLE NO | COMMENTS | FACIES/DEP. ENVIRONMENT



interlaminated silt : shale : vFsand (50:45:5)
• irregular bedding, silty wavy, occasional storm beds
• calcareous, rare crinoid fragments
• one solitary bivalve fragment
• calcareous •

1390.05 – 1390.25 vFg sand / silt interbeds
wavy sub-‖ low ∠ (5°) lamination

1390.4 l. fine sands, storm bed
hummocky, single palaeophycus burrow

"bioclastic" pebble conglomerate — 1

• brachiopod hash of shell fragments from 2-5mm to 1cm
• shale rip-ups or RF's of 0.5cm to several cm's
sometimes in discrete zones 5-10 cm thick of sand
matrix @ weakly scoured base — 2

1392.0 rafted, semi-consolidated shale bed?

unit had to gamma log to position core

• sharp upper contact
• erosive basal contact, low relief — 3, 4

black, calcareous shale
• avg ~5-10% silty or v.F. sand laminae
"turbidity current lamination"
local convolute bedding, local "loading"
some loading, v. rare flames — 5,6,7,8

1396.7 two thin (1-2cm) v.F. sand / silt beds
convolute lamination, some loading (?), lateral "loading"
of sand into [illegible] pods

1397.9, 1398.05 – 1398.10, 1398.40 – 1398.45
thin discontinuous lamination, sand "balls", planolites;
possible syneresis cracks @ base v.F. sand

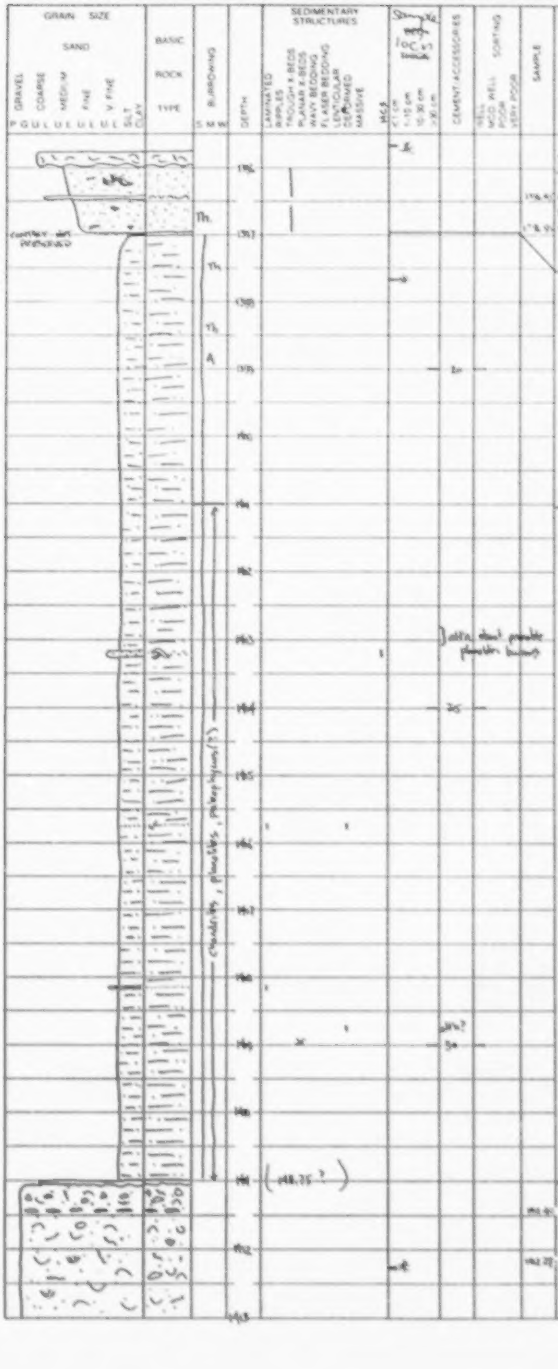
1399.0 curved "lens" of v. thin, vFg sand

1400.2 vFg sand 1mm → 1cm thick
2 syneresis cracks @ base
possible palaeophycus? and planolites
1400.3 1-2cm thick, vFg sand, HCS

1400.8 – 1401.05 ~20% thin (locally discontinuous)
fine silt / v.F. sand laminae
• minor ripple lamination, some curved [illegible]

WELL NAME: CANADIAN SUPERIOR BUICK  FORMATION: Doig  DATE: 02/23/93

LOCATION: b-44-I /94-A-11  CORE INTERVAL: 1395.00 - 1415.40  KB: 711.3


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
HCS
Sample No.
10 cm
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD. WELL
POOR
VERY POOR
SAMPLE
contact not preserved
Th.
Th.
Th.
A
1396
1397
1398
1399
1400
1401
1402
1403
1404
1405
1406
1407
1408
1409
1410
1411
1412
1413
chondrites, planolites, palaeophycus (?)
all'n about possible planolites burrows
25
20
30
alt'n?
(1411.25 ?)
1396.45
1396.94
1411.45
1412.27

COMMENTS

coarse bioclastic unit, biomoldic porosity
[illegible] erosive base

Lower fine sand, coarsens up to medium grain size
small rip-up clasts (2-3mm) @ base and, [illegible]
& fluid shedding @ 10°-20° => [illegible]?
• alteration along [illegible] → deep [illegible] mottled pattern
• only 1 trace → Thalassinoides @ 1396.91 (photo)

interlaminated vfg sand - silt - mud
tied to gamma log @ 1397.0 (contact)
• becomes progressively sandier upsection (i.e. [illegible])
but no apparent change in magnitude of [illegible]
• sedimentary structures uniformly distributed throughout:
ripples (low amplitude), wavy (?) lamination to parallel lamination
• trace assemblage includes palaeophycus + helminthopsis + planolites of skolithos & probable teichichnus
@ 1397.46 - 1397.51, 1398.99 - 1399.46;
max abundance @ 1398.00 - 1398.50
• calcareous

below 1401.0 there is progressively less sand overall, but still locally significant
• trace assemblage changes to:
chondrites, planolites, palaeophycus (?)

1402.8: alteration zone
appears laminated/mottled
→ all'n about planolites burrows?

1403.6 - 1403.78: HCS? ?

1405.76: 1 cm ∆ laminated vfg sand → microfaulted

1406.50: calcite-filled [illegible] scattered over ~1 m
(6 or 7 [illegible])

1408.15: 2.5cm ∆, vfg laminated sand,
sharp top, wavy base.
1408.70 irregular lamination
(conduit?, diagenetic?)
1408.85 - 1409.00 high angle lamination marked by alteration front @ 15°

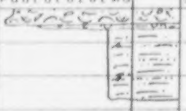
1411.02 - 1411.07 sand-supported, shale pebble (rounded mud clast?)
and shell fragment conglomerate w/ f. coarse sand
& erosive base
=> transgressive reworking of underlying unit?
1411.07 ~2cm ∆ irregular sand layer
1411.07 - 1413.21 PEBBLE-SHELL CONGLOMERATE
above 1411.49 - pebbles predominate
& [illegible] preserved from 1411.26 to 1411.49
& layered @ base, up to 2cm × 0.5cm

FACIES/DEP. ENVIRONMENT

B.B.L.
10
(Gm [illegible])

2 of 2

WELL NAME: CANADIAN SUPERIOR BUICK
FORMATION: DOIG
DATE: 02/23/93
LOCATION: b-44-I / 94-A-11
CORE INTERVAL: 1395.00 - 1415.40.
KB: 711.3



| GRAIN SIZE<br>SAND<br>GRAVEL COARSE MEDIUM FINE V FINE SILT CLAY<br>P G U L U L U L U L | BASIC ROCK TYPE | BURROWING<br>S M W | DEPTH | SEDIMENTARY STRUCTURES<br>LAMINATED RIPPLES TROUGH X-BEDS PLANAR X-BEDS WAVY BEDDING FLASER BEDDING LENTICULAR DEFORMED MASSIVE | Sample location<br><1 cm 1-10 cm 10-30 cm >30 cm | CEMENT/ACCESSORIES | SORTING<br>WELL MOD WELL POOR VERY POOR | PHOTO/SAMPLE NO | COMMENTS | FACIES/DEP ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | → | | | | 1411.49 - 1413.21 Bioclastic material dominates<br>often passively infilled w/ sediment<br>mostly brachiopods, bivalves + crinoids (?)<br>abundant calcite<br>+ 1413.10 - 1413.21 coarse polytypd "big"<br>shells up to 5+ cm long (2 cm common)<br>rare vertically oriented shells<br>1413.21 - 1413.26<br>interlaminated fine grain (<5 mm) shelly hash (brachiopods)<br>w/ silty mud laminae few mm thick<br>NB there is no pronounced basal erosive contact<br>to above bioclastic conglomerate<br>+ contact located btwn 2 core fragments<br>w/ do not fit perfectly, but do not appear<br>to be milled or reduced in volume<br>1413.26 - 1414.37<br>interlaminated vfg sand - silt - mud ; ~ 20% sand<br>dark grey - black , calcareous<br>+ ripple X-stratification locally dist.<br>→ locally mimics HCS | |
| | | | 1414 | | — | 35 | — | | | |
| | | | 1415 | | | | | | | |

WELL NAME: ANADARKO BUCK

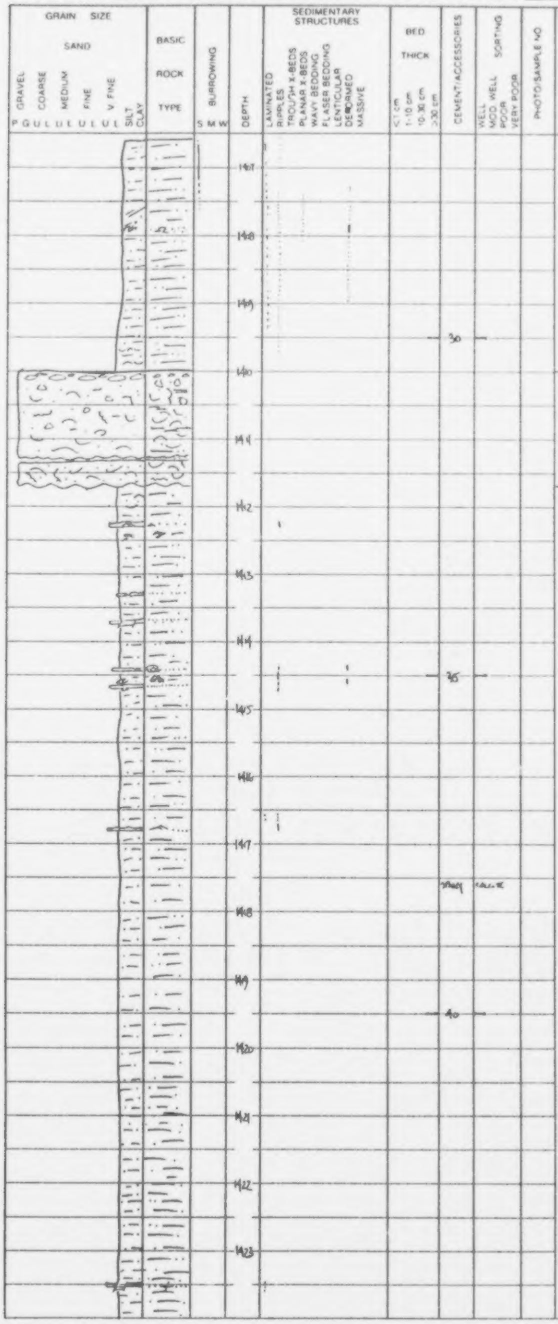
FORMATION: DOIG

DATE: 02/22/93

LOCATION: d-45-I /94-A-11

CORE INTERVAL: 1406.6 - 1425.3 (actual)<br>1408.0 - 1427.0 (on label)

KB: 690.6



GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD. WELL
POOR
VERY POOR
PHOTO/SAMPLE NO.
1407
1408
1409
1410
1411
1412
1413
1414
1415
1416
1417
1418
1419
1420
1421
1422
1423
30
35
40
sharp
calcite

COMMENTS

v.f. sandy silt, fining-up to silt with sand
- local thin ‖ laminations of coarse silt & l. vfg sand
- some "mottled" alteration

- overdeepened bedding culminates in contorted slump folds @ 1407.9 (steepen to ≈ 40° below slump)
- overdeepened laminations @ top interval (25-40°)

- mottling due to bioturbation? (palaeophycus, helminthopsis)

"brecciated" pebble conglomerate as in d-36-I (w/out crinoid sand @ base)
- predominantly brachiopod-crinoid hash w/ only rare shale pebbles
  sharp upper contact
  erosive lower contact, but of minimal relief

* tied to gamma log to position core

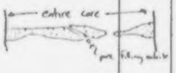
Calcareous, black silty shale

1411.82 - pyritic zone

v.f. sandy to muddy silt with minor rippled to ‖ laminated v.f. sand

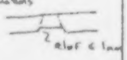
1412.95 - HCS(?) or wavy planar ‖ lamination

1413.4 - vfg sand 2 cm thick slumped/sheared?



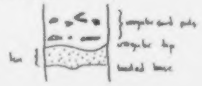
entire core
pore filling calcite

1413.8 - 5 mm vfg sand/silt laminations microfaulted base



1414.5 - vfg sand ~ 1 cm thick convolute lamination

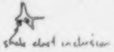
1415.15 - 1415.20



irregular sand pods
irregular top
loaded base
1 cm

1416.7 - thin (5-7 mm), weakly rippled vfg sand rotated ripples in overlying 2-3 cm

1417.6 - cross shaped pore filled w/ sparry calcite



shale clast inclusion

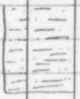
1420.5 3 mm vfg sand microfaulting

FACIES DEP. ENVIRONMENT

8 to 1 (9)(10)

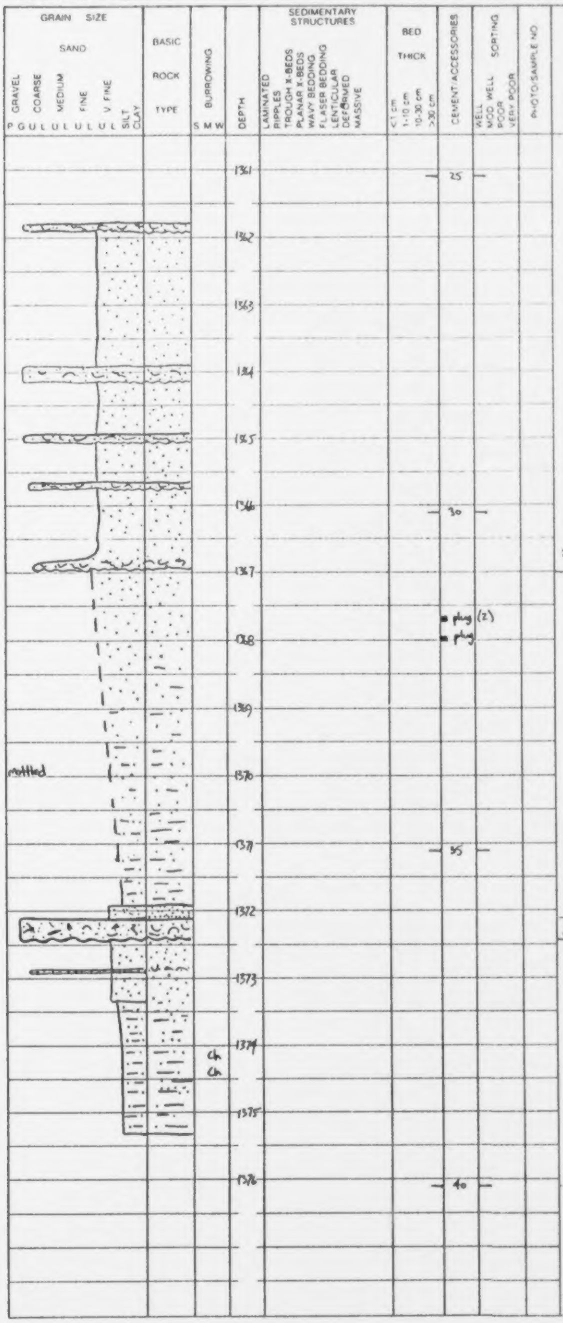
8 to 1 (5)-(7)

WELL NAME: ANADARKO BUCK
FORMATION: DOIG
DATE: 02/22/93
LOCATION: d-45-I/94-A-11
CORE INTERVAL: 1406.6 to 1425.3 / 1408.0 - 1427.0
KB: 690.6

| GRAIN SIZE (GRAVEL, SAND: COARSE, MEDIUM, FINE, V. FINE; SILT, CLAY) P G U L U L U L U L | BASIC ROCK TYPE | BURROWING S M W | DEPTH | SEDIMENTARY STRUCTURES (LAMINATED, RIPPLES, TROUGH X-BEDS, PLANAR X-BEDS, WAVY BEDDING, FLASER BEDDING, LENTICULAR, DEFORMED, MASSIVE) | BED THICK (<1 cm, 1-10 cm, 10-30 cm, >30 cm) | CEMENT/ACCESSORIES | SORTING (WELL, MOD WELL, POOR, VERY POOR) | PHOTO/SAMPLE NO | COMMENTS | FACIES/DEP ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|
|  | | | 1424 | | | | | | section becomes progressively finer down section | |
| | | | | | | 45 | | | | |
| | | | 1425 | | | | | | | |

WELL NAME: Skye ET AL. Buick d-46-I FORMATION Doig DATE 08/23/93

LOCATION: d-46-I /94-A-11 CORE INTERVAL: 1361.8 - 1375.3 KB: 675.9


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO.
1361
1362
1363
1364
1365
1366
1367
1368
1369
1370
1371
1372
1373
1374
1375
1376
25
30
35
40
plug (2)
plug
mottled
Ch
Ch

COMMENTS

FACIES/DEP. ENVIRONMENT

Bt w

Fine to v.fine qtz arenite
+ carbonate cement, locally intensely dolomitization
+ several bioclastic zones @ :
1361.80 - 1361.90
1363.87 - 1364.13
1364.94 - 1365.04
1365.65 - 1365.77
=> zones appear "brecciated", but likely alteration/dolomitization associated with either storm rip-ups, or may be some original limestones in sequence

12

13

20cm Σ bioclastic zone, predominantly bivalves erosive base

generally coarsening-up from vfg sandy-silt to lower-fine sand

~1370.0: mottled appearance to vfg silty-sand/sandy silt

bioclastic conglomerate unit, minor shale clasts + abundant biomoldic porosity

14

interbioturbated silts & mud of some v.f. sand
+ locally superabundant chondrites over 2 to 3 cm Σ intervals
(eg: 1374.4, 1374.25)
+ trace assemblage: chondrites, planolites, helminthopsis
+ calcareous throughout, locally dolomitized
+ sands discontinuous
1372.88 - 1372.95 : abundant bivalve frags. possible rip-ups, some (minor) vertically oriented bivalves

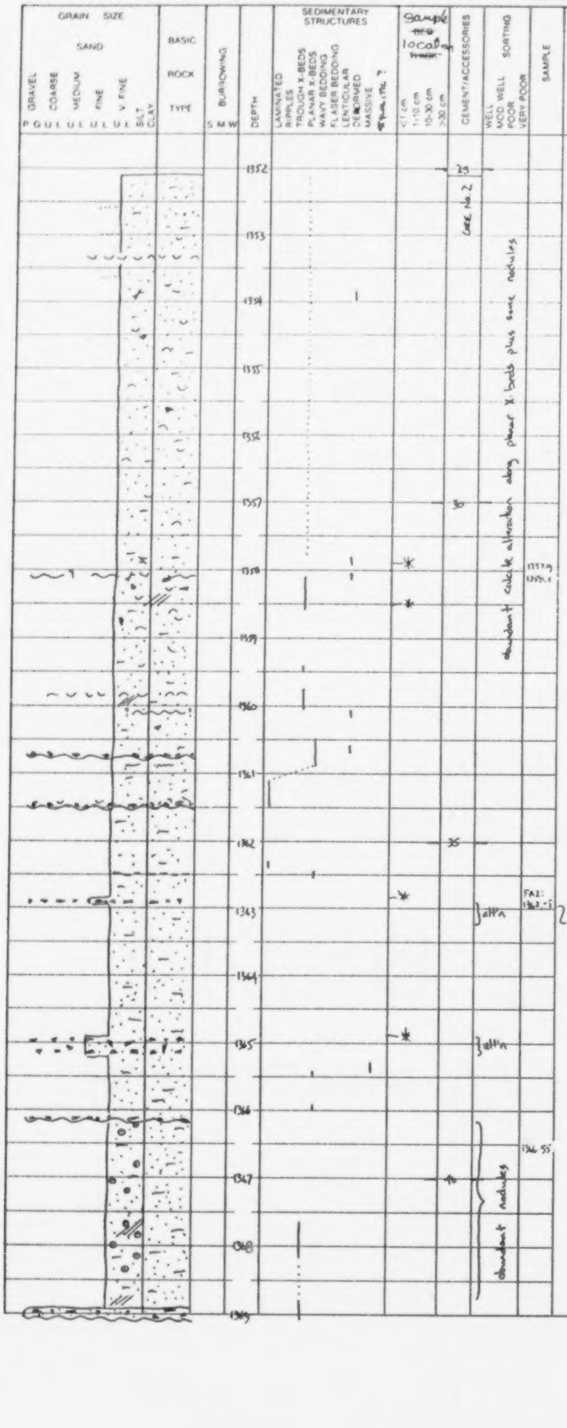
17 V

15

16

1 of 2

WELL NAME: Pico Buck
FORMATION: Doig
DATE: 02/24/93
LOCATION: d-A57-I/94-A-11
CORE INTERVAL: 1352.1 - 1372.1
KB: 678.96



GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
Tabular ?
~~BED~~ Sample location ~~THICK~~
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
SAMPLE
1352
1353
1354
1355
1356
1357
1358
1359
1360
1361
1362
1363
1364
1365
1366
1367
1368
1369
35
30
35
CORE No 2
abundant calcite alteration along planar x beds plus some nodules
alt'n
alt'n
abundant nodules
1357.9
1358.1
FA2: 1362.5
1366.55

COMMENTS

v.f. sand, calcareous
- low angle planar tabular bedding @ 10° noted locally, marked by preferential calcite cement.
- minor fracturing w/ up to 2cm displacement
- some 1 cm Σ fine sand laminae
- scattered 1mm mud rip-ups
- ~ 1% biomoldic porosity
- laminae tend to be discontinuous

several "cycles" present w/ are marked at base by weakly defined zones with shale rip-up clasts +/- shell fragments
contacts:
- base generally sharp, marked by change in colouration from dark grey to bleached grey
- no apparent Δ gz
- "bleaching" (above contact) equals zones of increased calcite

⇒ this same ↑ calcite/alteration accounts for development of nodules.

- nodules also appear to have relatively more calcite and mud rip ups than other areas; but this is not uniformly true.

- calcite locally ppt's along bedding planes of low ∠ planar tabular beds
⇒ elsewhere these bedding planes are bitumen saturated

- in some instances, "nodule" growth displaces x-bedding

NOTE: B&W photos #18-24 on roll #1
B&W photos #1-15 on roll #2

Dacrella

⊙ - nodules

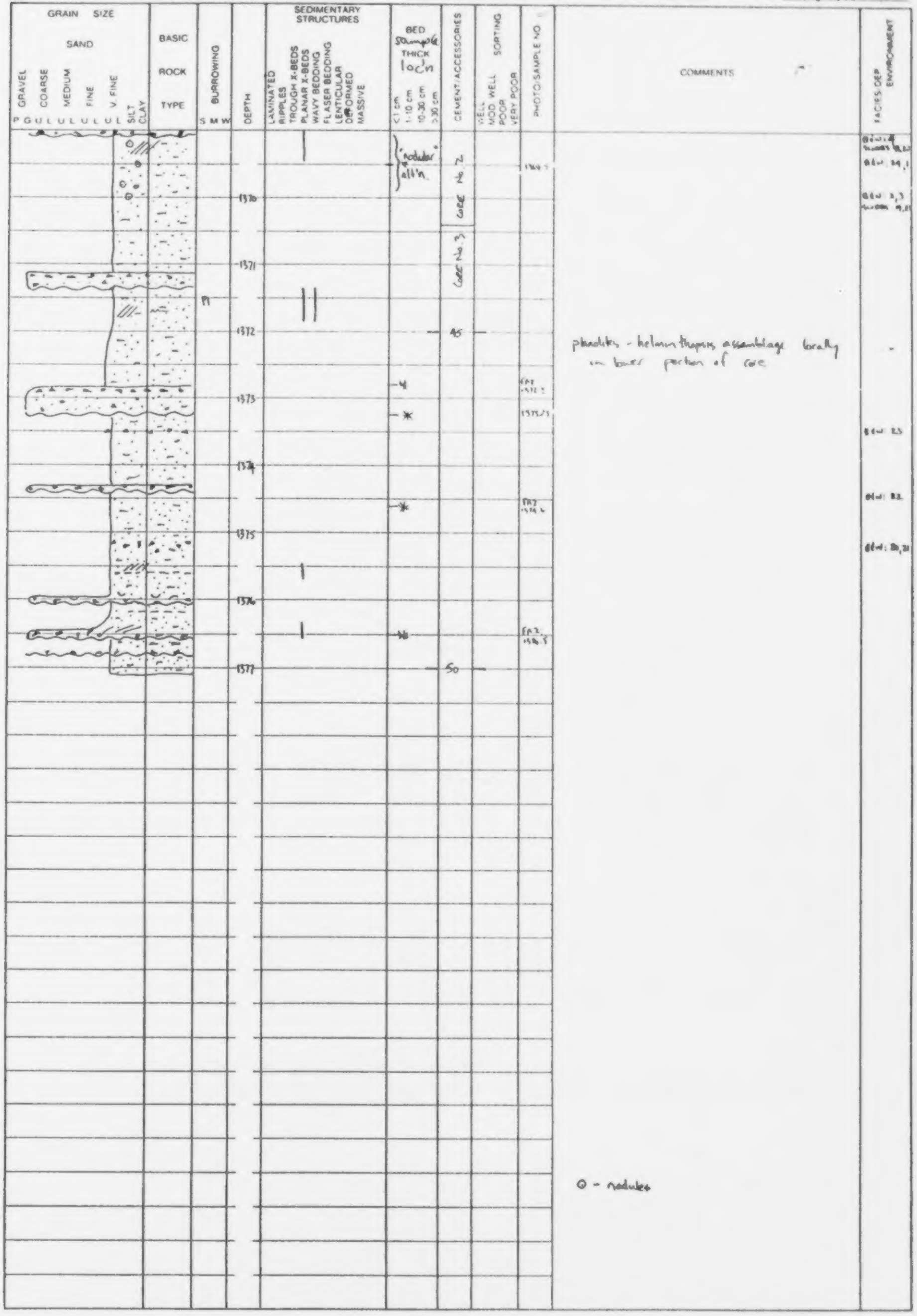
FACIES DEP ENVIRONMENT

B&W: 13-15
B&W: 9-12
B&W: 8
B&W: 7
B&W: 6
B&W: 5
B&W: 18,19

2 of 2

WELL NAME: Poco Buck FORMATION: Doig DATE: 02/24/93

LOCATION: d-A57-I/94-A-11 CORE INTERVAL: 1352.1 - 1377.1 KB 673.96'



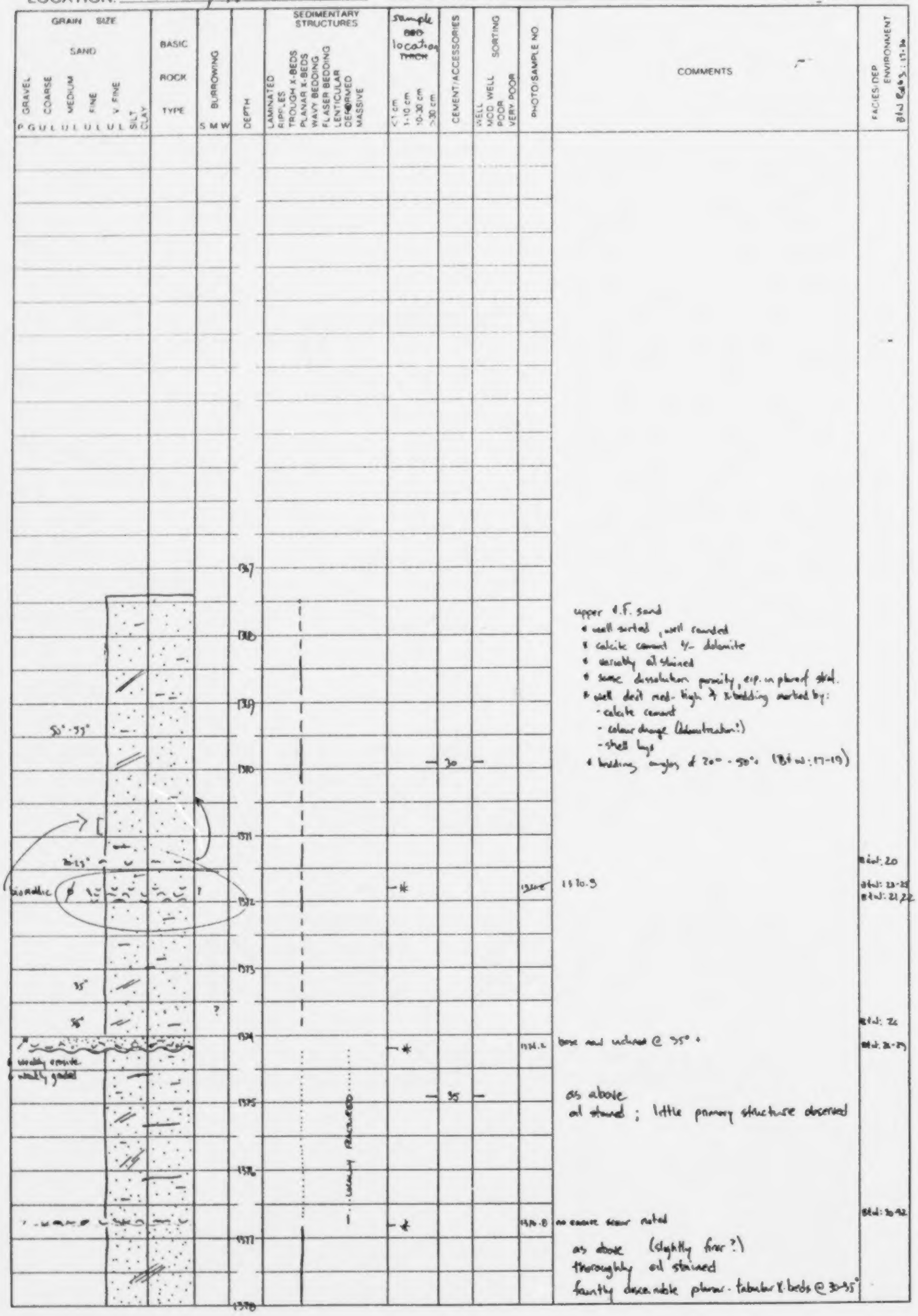
GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED sample THICK loc'n
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO.
COMMENTS
FACIES-DEP ENVIRONMENT
1370
1371
1372
1373
1374
1375
1376
1377
"nodular" alt'n
CORE No. 2
CORE No. 3
45
50
FR2 1372.5
FR2 1374.6
FR2 1376.5

phaolites - helminthopsis assemblage locally in lower portion of core

○ - nodules

1 of 2

WELL NAME: Poco Buck d-58-I
FORMATION: Doig
DATE: 02/26/93
LOCATION: d-58-I / 94-A-11
CORE INTERVAL: 1367.4 - 1385.5
KB:


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
sample ~~BED~~ location ~~THICK~~
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP ENVIRONMENT
Bld Rd #s: 17-36
1367
1368
1369
1370
1371
1372
1373
1374
1375
1376
1377
1378
50°-55°
20-25°
bioturbation
?
35°
35°
?
* weakly erosive
* weakly graded
locally fractured
*
*
*
30
35

upper v.F. sand
- well sorted, well rounded
- calcite cement +/- dolomite
- variably oil stained
- some dissolution porosity, esp. in planar strat.
- well devt med-high ∠ x-bedding marked by:
  - calcite cement
  - colour change (dolomitization?)
  - shell lags
- bedding angles of 20° - 50°. (Bd rd: 17-19)

Bd rd: 20

1370.5 — 1370.5
Bd rd: 23-25
Bd rd: 21,22

Bd rd: 26

1374.2 — base ~~and~~ inclined @ 35° +
Bd rd: 28-29

as above
oil stained; little primary structure observed

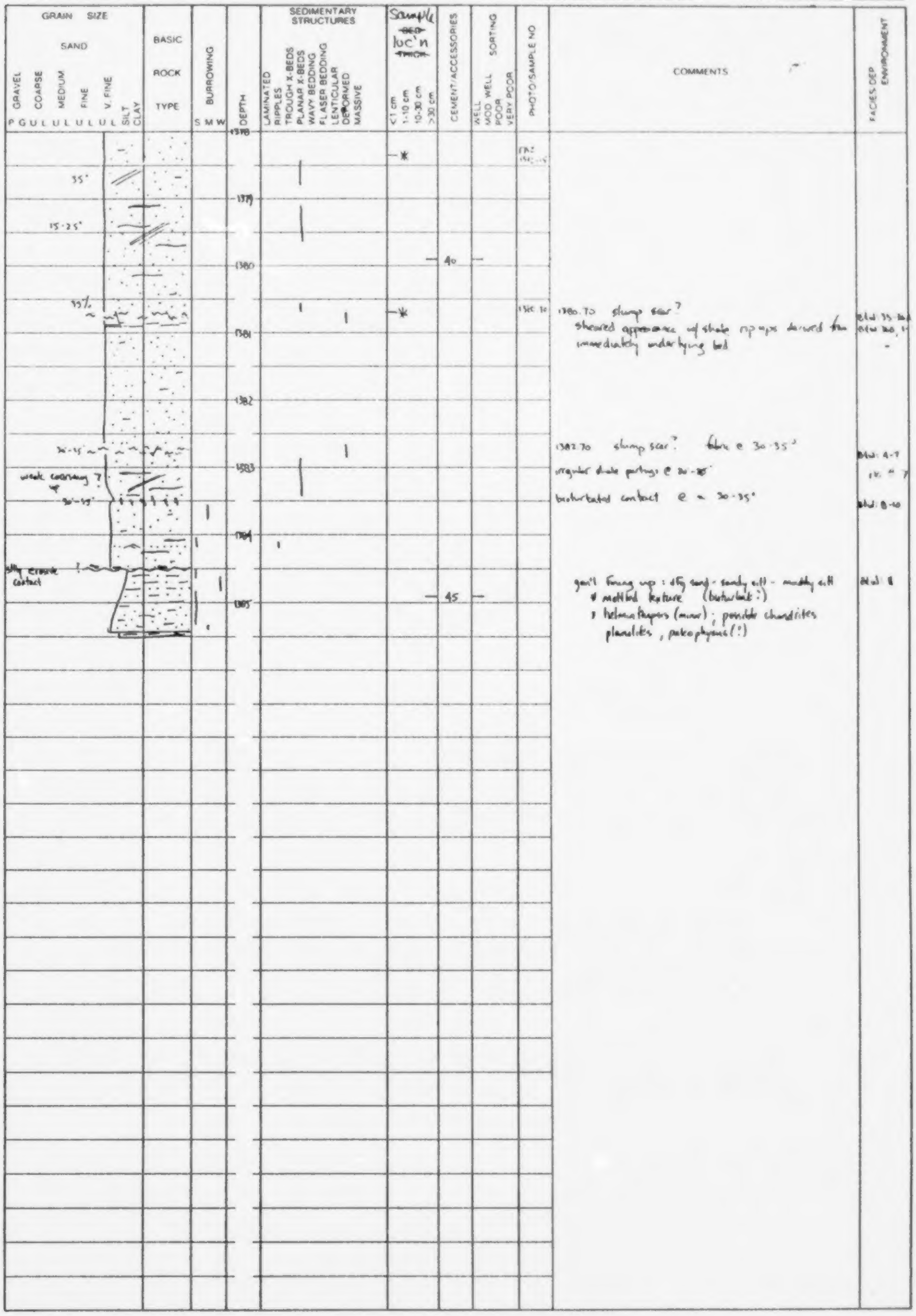
1376.8 — no erosive scour noted
Bd rd: 30-32

as above (slightly finer?)
thoroughly oil stained
faintly discernible planar-tabular X-beds @ 30-35°

2-2

WELL NAME: Poco Buck d-58-I FORMATION: Dog DATE: 02/26/93

LOCATION: d-58-I /94-A-11 CORE INTERVAL: 1377.4 - 1385.5 KB: -



GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
Sample ~~BED~~ loc'n ~~THICK~~
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES DEP. ENVIRONMENT
1378
1379
1380
1381
1382
1383
1384
1385
35°
15-25°
35%
30-35°
weak coarsening ?
30-35°
silty erosive contact
40
45
1380.70

1380.70 slump scar?
Sheared appearance of shale rip-ups derived from immediately underlying bed

Bld: 35-36
Bld 30, 1

1382.70 slump scar? fabric @ 30-35°

irregular shale partings @ 30-35°

bioturbated contact @ ~ 30-35°

Bld: 4-7
1K: " 7

Bld: 8-10

gen'l fining up: vfg sand - sandy silt - muddy silt
* mottled texture (bioturbated?)
* helminthopsis (minor); possible chondrites planolites, palaeophycus (?)

Bld: 8

1 of 2

WELL NAME: Kwo Buck d-68-I

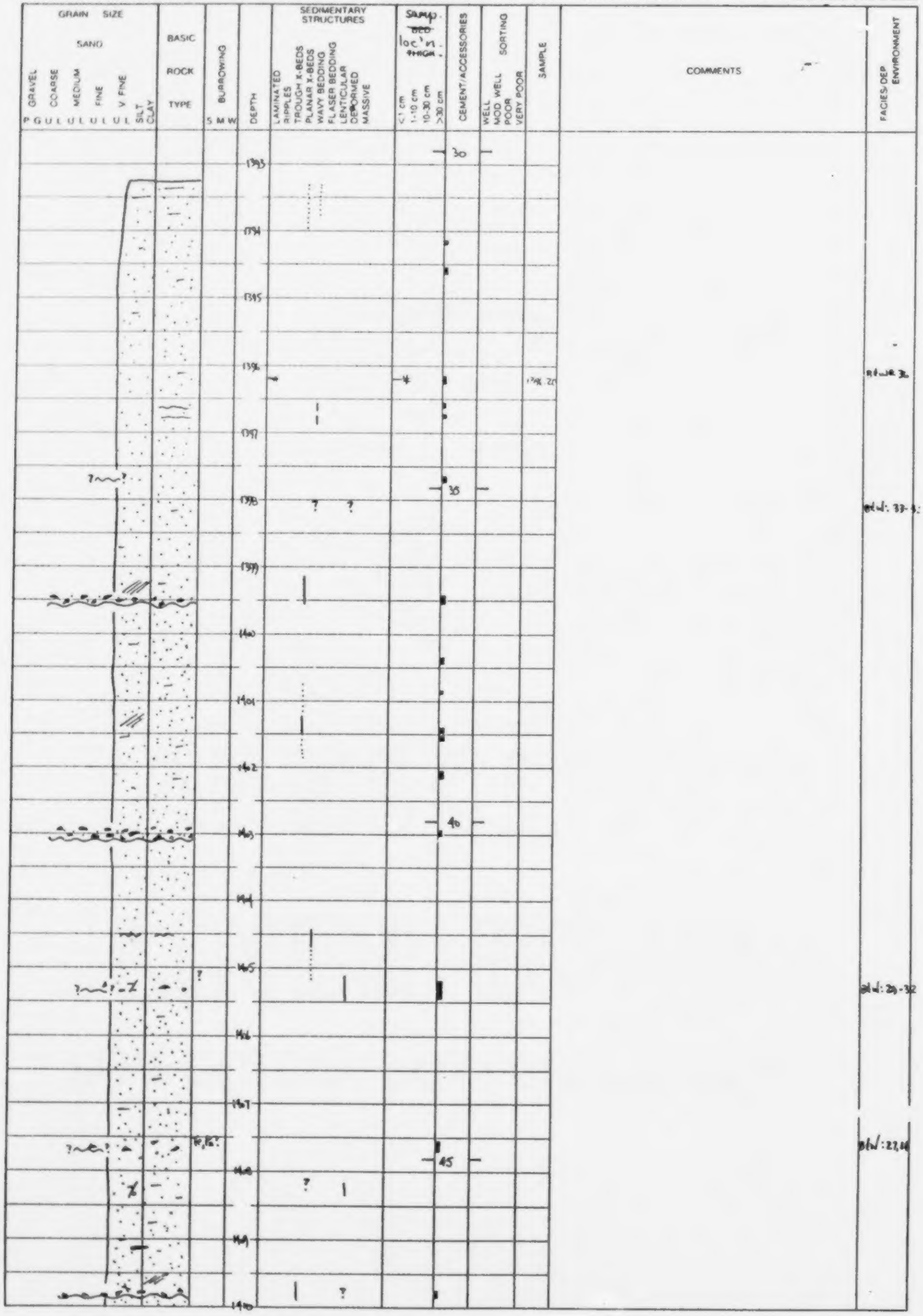
FORMATION: Doig

DATE: 02/25/93

LOCATION: d-68-I/94-A-11

CORE INTERVAL: 1393.3 - 1417.4

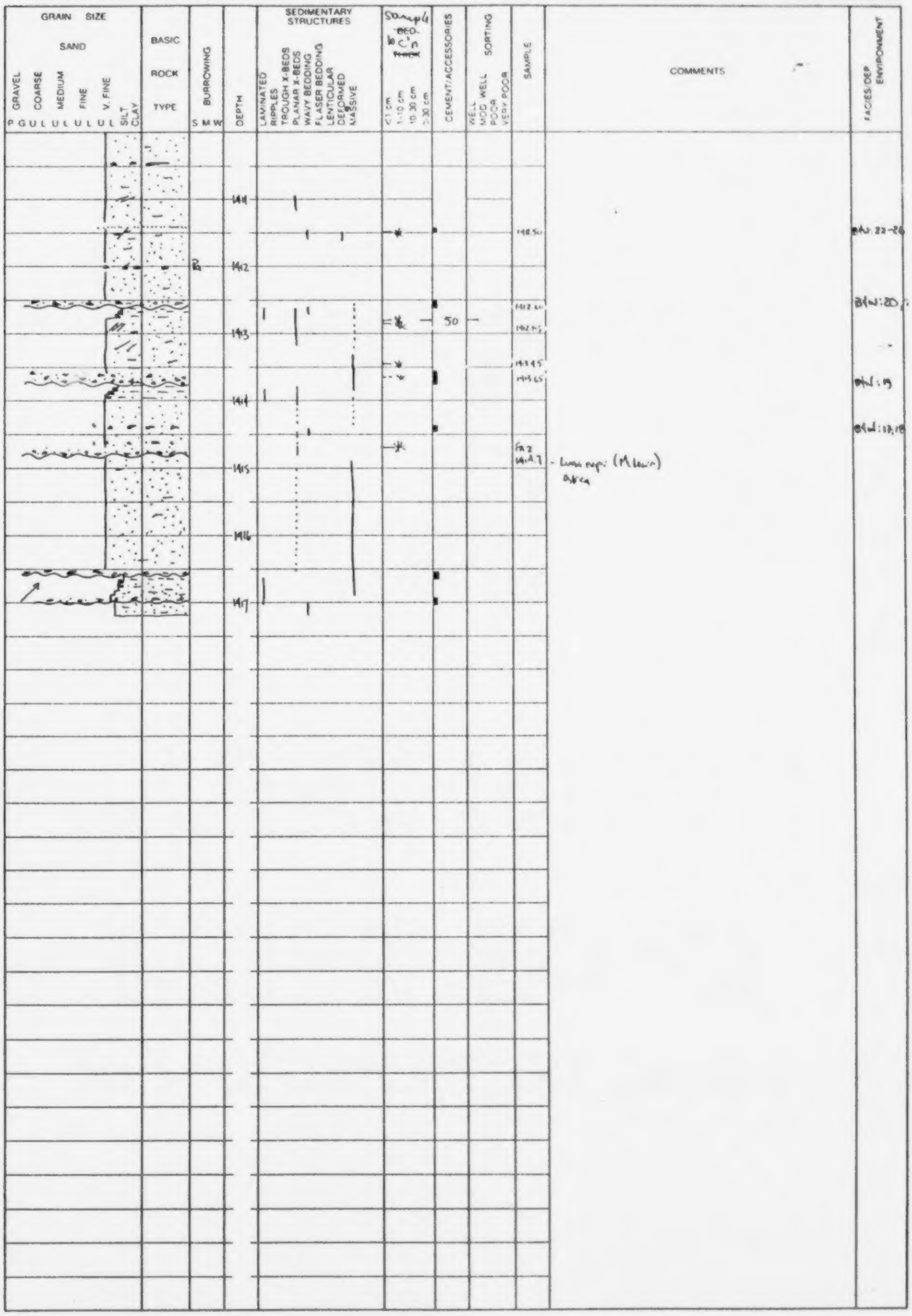
KB: 714.63


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
Samp.
~~BED~~
loc'n.
~~THICK.~~
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
SAMPLE
COMMENTS
FACIES/DEP ENVIRONMENT
30
1393
1394
1395
1396
1396.20
1397
35
1398
?
?
1399
1400
1401
1402
40
1403
1404
1405
?
1406
1407
45
1408
?
1409
1410
?

2 of 2

WELL NAME: Keo Buse d-68-I
FORMATION: Doig
DATE: 02/25/93

LOCATION: d-68-I /94-A-11
CORE INTERVAL: 1393.3 - 1417.4
KB: 714.63

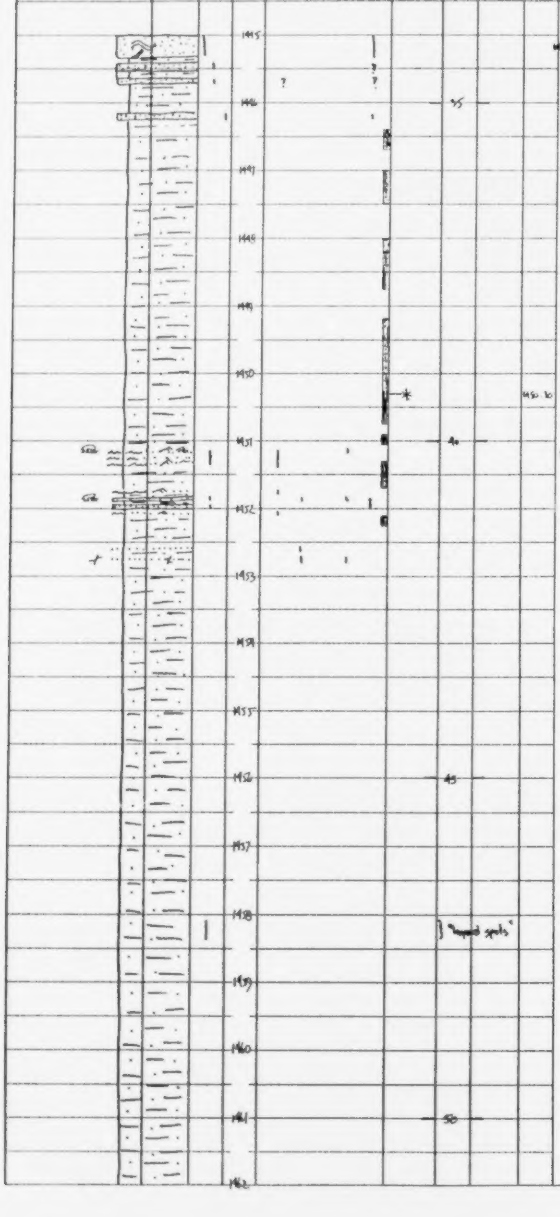

GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
Sample ~~BED~~ to C'n ~~THICK~~
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
SAMPLE
COMMENTS
FACIES/DEP ENVIRONMENT
1411
1412
1413
1414
1415
1416
1417
50
1411.50
1412.60
1412.85
1413.45
1413.65
Fa 2
1414.7
- Lam rip? (Mlewin) area
BW: 22-26
BW: 20
BW: 19
BW: 17, 18

1 of 2

WELL NAME: Kobes d-69-I FORMATION: Doig DATE: 02/26/93

LOCATION: d-69-I / 94-A-11 CORE INTERVAL: 1445 - 1467 (2 cores) KB: 748.5

GRAIN SIZE: GRAVEL, SAND (COARSE, MEDIUM, FINE, V.FINE), SILT, CLAY — P G U L U L U L U L | BASIC ROCK TYPE | BURROWING S M W | DEPTH | SEDIMENTARY STRUCTURES: LAMINATED, RIPPLES, TROUGH X-BEDS, PLANAR X-BEDS, WAVY BEDDING, FLASER BEDDING, LENTICULAR, DEFORMED, MASSIVE, Hummocky X-strat | Samp. ~~BED~~ loc'n ~~THICK~~ <1 cm, 1-10 cm, 10-30 cm, >30 cm | CEMENT/ACCESSORIES | SORTING: WELL, MOD. WELL, POOR, VERY POOR | PHOTO/SAMPLE NO. | COMMENTS | FACIES/DEP. ENVIRONMENT B4W Ross #4


1445
1446
1447
1448
1449
1450
1451
1452
1453
1454
1455
1456
1457
1458
1459
1460
1461
1462
35
40
45
50
Sed
Gd
1450.30
} "[illegible] spots"
?

1445 reworked HCS, partly to thoroughly reworked
palaeophycus, fugichnia, . . . ?

B4d:22

black, calcareous (limey), silty mudstone
& local (but minor) palaeophycus, helminthopsis,
possible chondrites and "micro palaeophycus"
↳ burrows a 2-4mm Δ

core locally has a "tiger stripe" appearance
where it is med grey w/ darker, discontinuous
stripes
⇒ this may be diagenetic alt'n
⇒ or thoroughly reworked storm beds?

B4d:23

1451.15 - 1451.35: 6 x 3-8mm Δ rippled beds

B4d:20,21

B4d:17-19
B4d:16

B4d:15

B4d:13,14

2 of 2

WELL NAME: Kilo Buick A-69 -I

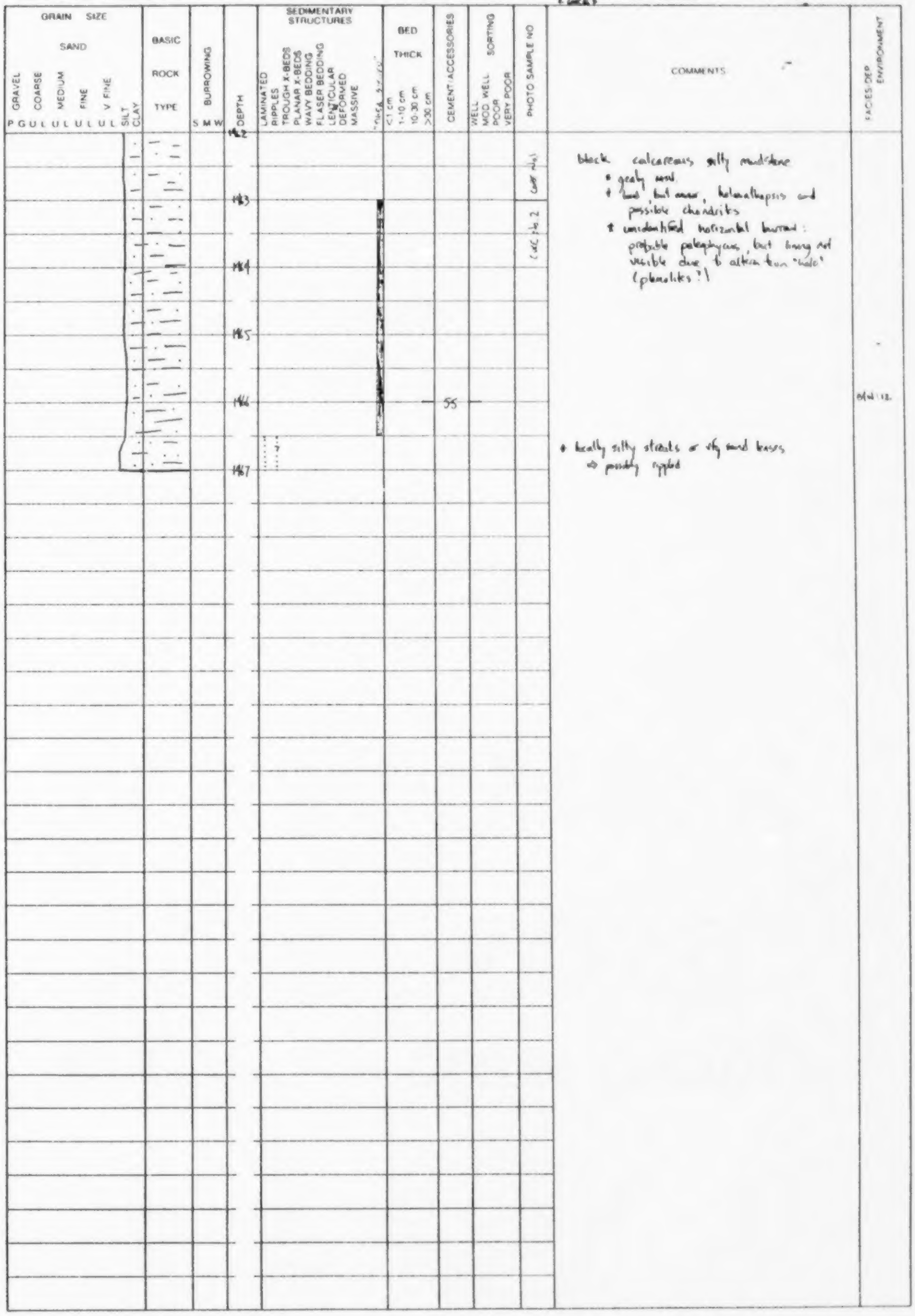
FORMATION: Dog

DATE: 02/26/93

LOCATION: d-69-I /94-A-11

CORE INTERVAL: 1445 - 1467
2 boxes

KB: 748.5


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO SAMPLE NO
COMMENTS
FACIES/DEP. ENVIRONMENT
1462
1463
1464
1465
1466
1467
55
core pho.1
core pho.2
B/W 12.

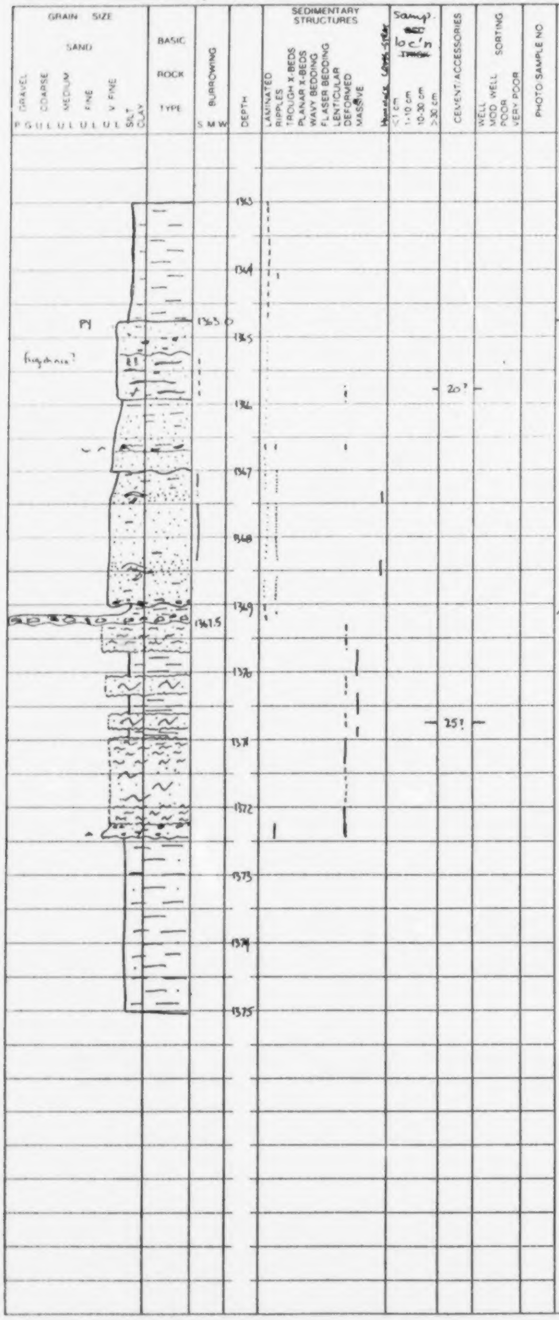
black calcareous silty mudstone
- * gently mod.
- * bad, but rare, helminthopsis and possible chondrites
- * unidentified horizontal burrow: probable palaeophycus, but lining not visible due to alteration "halo" (planolites?)

- * locally silty streaks or vfg sand lenses
  - ⇒ possibly rippled

1 of 3

WELL NAME: Esso Gulf Buick d-76-I FORMATION: Doig DATE: 03/01/93

LOCATION: d-76-I/94-A-11 CORE INTERVAL: ~~1363.0 - 1375.0~~ 1361.25 - 1373.25 KB: 694.8


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
Samp. loc'n
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD. WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
PY
fugichnia?
1363.0
1367.5
1363
1364
1365
1366
1367
1368
1369
1370
1371
1372
1373
1374
1375
20?
25?

COMMENTS

Core No. 3

- basal Halfway parasequence?

brown-black calcareous mudstone
· few thin (~1mm) parallel silt laminae

- mineralized (pyritized) contact.

HALFWAY

DOIG

vfg silty sand and sandy silt
- parallel laminated or possibly LA (<2°)
- some thin (2-4mm) ripple laminated sands

- local wispy shale partings or rip-ups (visible on bedding planes)

- variable bioturbation

TURBIDITE : v.coarse (cobble) Ta unit

Intercalation of "slump beds" with gritty now dark muds
"slump beds"
- mud clasts/rip-ups/autobreccia & discontinuous, distorted mud laminations
- flooded with calcite cement (white coloration)
- deformed zone?
- slump scar?

⇒ - likely shear imposed by alternating currents(?)

generally massive mudstone
calc, black
- rare faint ∥ laminations or "wispy" silt laminae

~~~~ ] intense soft sediment shear

∿ ∿ ] subtle soft sediment shear

FACIES/DEP ENVIRONMENT

Bd No.5

Bd: 7,8

Bd: 6

Bd: 9-16

Bd: 17-19
~~~~

2 of 3

WELL NAME: Esso Gulf Bent

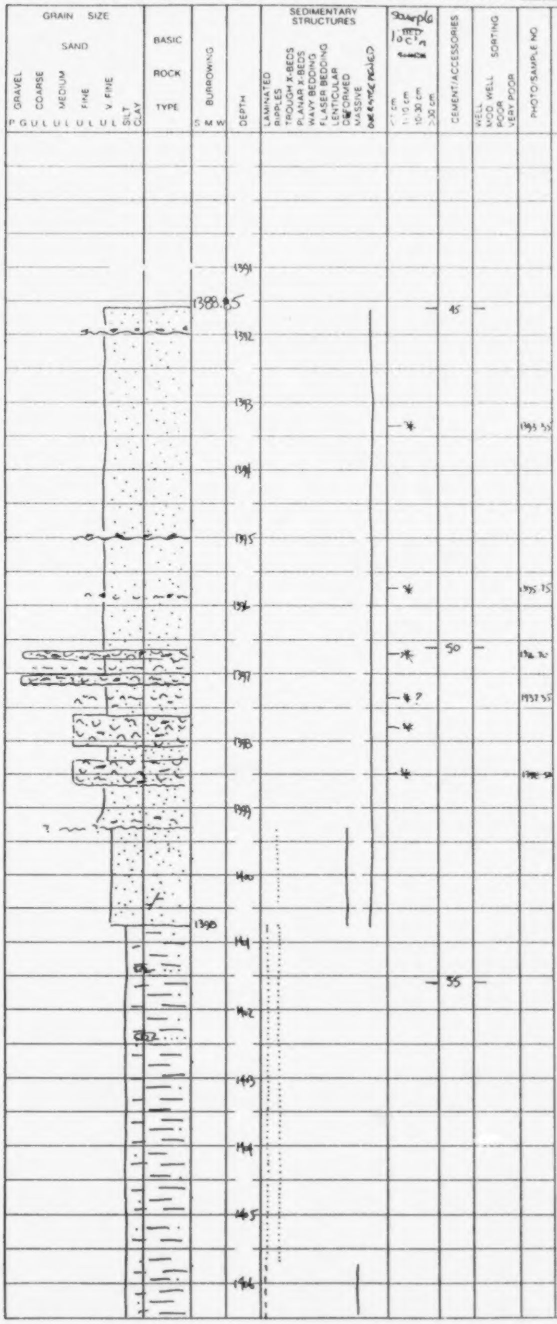
FORMATION: Doig

DATE: 03/01/93

LOCATION: d-76-I /94-A-11

CORE INTERVAL: 1388.85 – 1416.85 ~~1391.6~~ – 1409.6

KB: 694.8


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
OVERSTEEPENED
Sample
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO.
1391
1388.85
1392
1393
1394
1395
1396
1397
1398
1399
1400
1398
1401
1402
1403
1404
1405
1406
45
50
55
1393.55
1395.75
1396.30
1397.35
1398.50

COMMENTS

Core No. 4

lower to upper V.F. sandstone
- locally bitumen stained
- locally calcite flooded w/ cements w/ may be nodular but gently lie in plane of bedding (BS ... 23)
- high angle tabular X-beds → oversteepened 35 – 45°

bioclastic, shell fragment, mud rip-up conglomerates
- up to 10% biomoldic porosity

interlaminated silty vfg sand and sandy silt w/ mud
- soft sediment deformation, some degree of bedding-parallel shear, some microfractures
- locally rippled-to-wavy sands/muds

black, silty, calcareous mudstone
- thin silt or vfg sand stringers a few mm ≤ → may be planar ll or faint conduct laws.
- series (Tc-e), Td,e, Te ?
- progressively less silt/no sand down-section below ≈ 1405.50

FACIES/DEP. ENVIRONMENT

Bl-I Bed 5

Bl-I: 23, 24

Bl-I: 23

Bl-I: 1

Bl-I: 2-4

Bl-I: 5

Bl-I: 24

Bl-I: 6-4

Bl-I: 15

Bl-I: 16

Bl-I: 17

Bl-I: 18-2

WELL NAME: Esso Gulf Bruce d-76-I

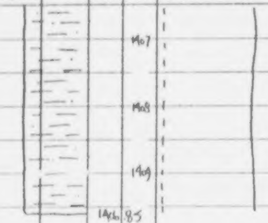
FORMATION: Dolh

DATE: 03/01/93

LOCATION: d-76-I /94-A-11

CORE INTERVAL:

KB: 694.8

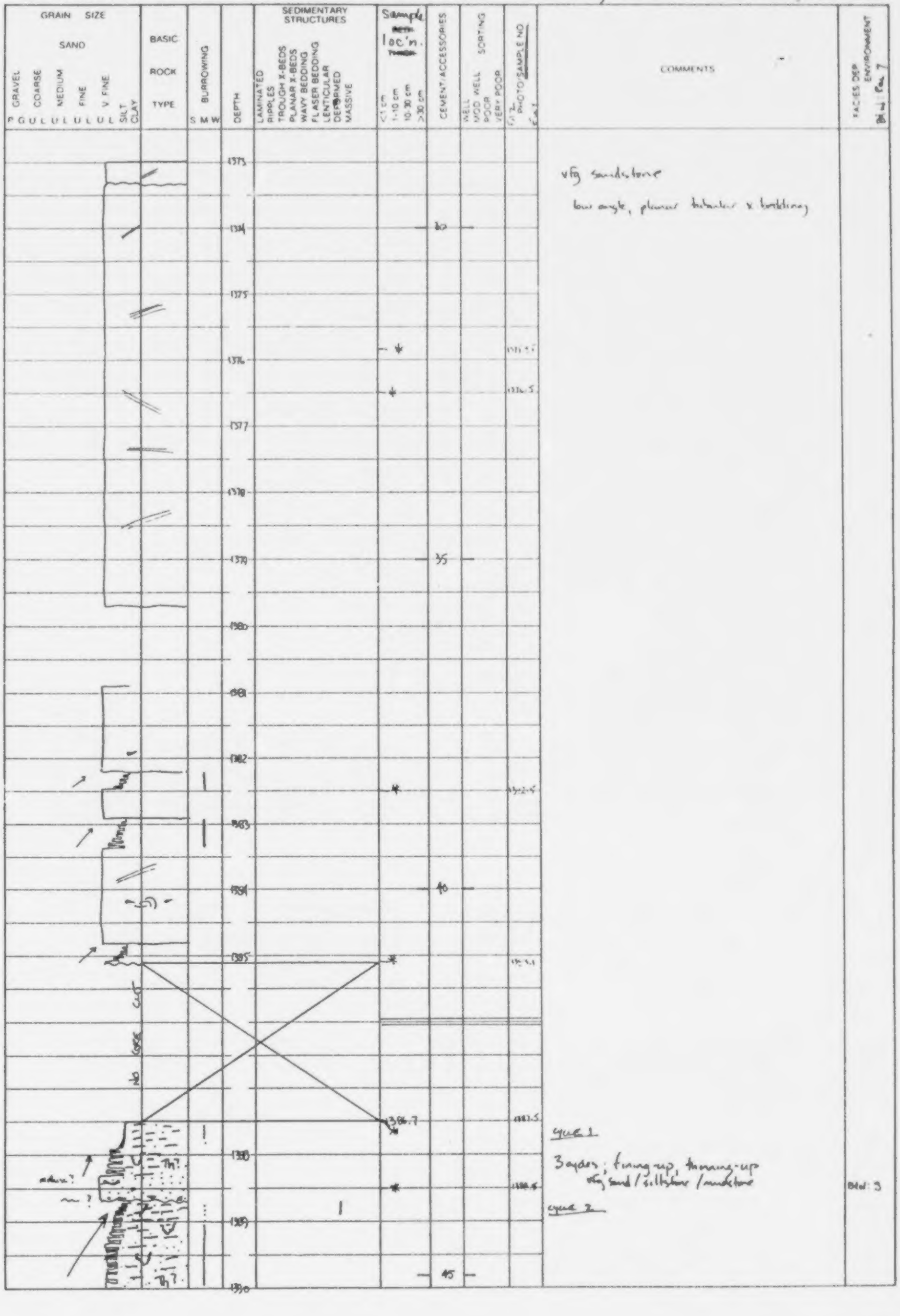


| GRAIN SIZE (GRAVEL, SAND: COARSE, MEDIUM, FINE, V FINE; SILT, CLAY) P G U L U L U L U L | BASIC ROCK TYPE | BURROWING S M W | DEPTH | SEDIMENTARY STRUCTURES (LAMINATED, RIPPLES, TROUGH X-BEDS, PLANAR X-BEDS, WAVY BEDDING, FLASER BEDDING, LENTICULAR, DEFORMED, MASSIVE) | BED THICK (<1 cm, 1-10 cm, 10-30 cm, >30 cm) | CEMENT/ACCESSORIES | SORTING (WELL, MOD WELL, POOR, VERY POOR) | PHOTO/SAMPLE NO | COMMENTS<br>CORE No. 4 | FACIES/DEP ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | — | 60 | — | | black, calc. mudstone | |
| | | | 1407 | | | | | | | |
| | | | 1408 | | | | | | | |
| | | | 1409 | | | | | | | |
| | | | 1406.85 | | | | | | | |

1 of 2

WELL NAME: Texaco Et Al. Buick b-71-I FORMATION: Doig DATE: 03/01/93

LOCATION: b-71-I /94-A-11 CORE INTERVAL: 1373.0-1385.1 ; 1386.7-1403.8 1387.5-1404.6 KB: 700.8


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
Sample ~~BED~~ loc'n. ~~THICK~~
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
~~PHOTO~~/SAMPLE NO
COMMENTS
FACIES DEP ENVIRONMENT
Bed Pac 7
1373
1374
1375
1376
1377
1378
1379
1380
1381
1382
1383
1384
1385
1388
1389
1390
30
35
40
45
1375.5
1376.5
1382.5
1385.1
1386.7
1387.5
1388.5
NO CORE CUT
Th?
Th?
erosive?
~ ?

vfg sandstone

low angle, planar tabular x bedding

cycle 1

3 cycles; fining-up, thinning-up
vfg sand / siltstone / mudstone

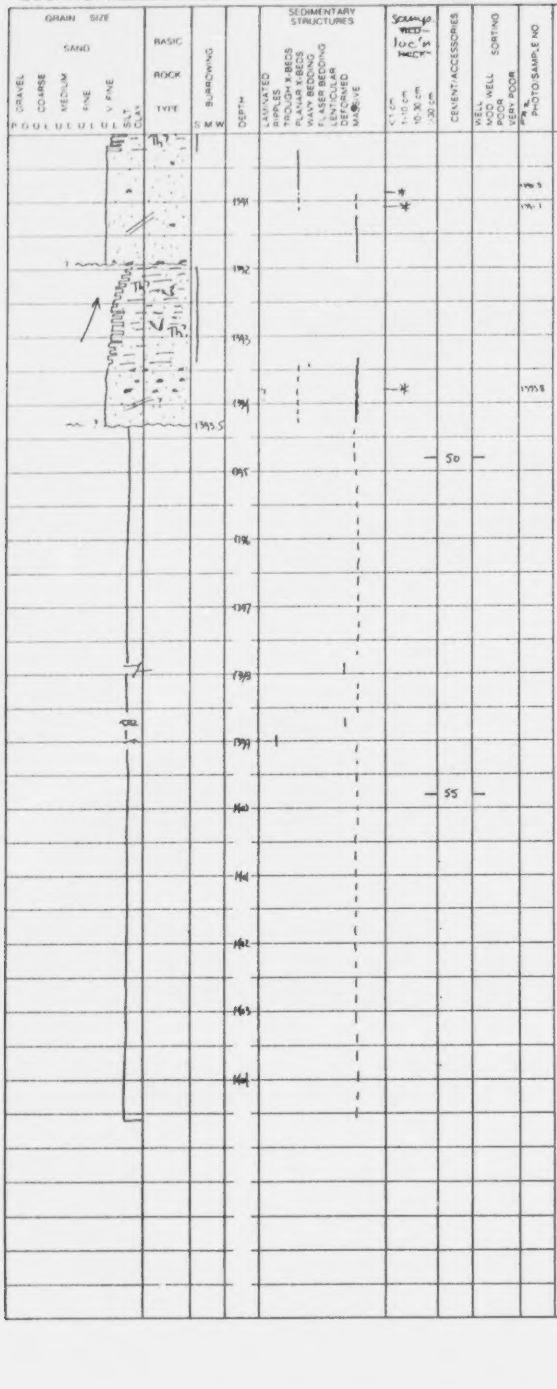
cycle 2

Bed: 3

2 of 2

WELL NAME: TEXACO ET AL. BLACK b-77-I FORMATION: Doig DATE: 03/01/93

LOCATION: b-77-I/94-A-11 CORE INTERVAL: 1373.0-1385.1 ; 1387.5-1404.6 KB: 701.8


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
Samp. loc'n
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
Th?
Th?
Th?
1391
1392
1393
1394
1393.5
1395
1396
1397
1398
1399
1400
1401
1402
1403
1404
1390.5
1391.1
1393.8
50
55

COMMENTS

(cycle 2 con'd)

interbedded vfg sand : silt . mud

cycle 3:
interbedded vfg sand - siltstone - mudstone
in a fining-up, thinning-up cycle
+ erosive base
+ local rip-up clasts
+ planolites, chondrites, thalassinoides ?
+ SYNAERESIS CRACKS

As at base d-76-I/94-A-11
black, silty, calcareous mudstone
+ thin silt or vfg sand laminae ≤ 2-3 mm
+ plane ll laminations locally
+ minor rippled/convolute lamination
+ generally mw

FACIES/DEP ENVIRONMENT

BAJ Roll 6: 22-25

Bld: 1,2

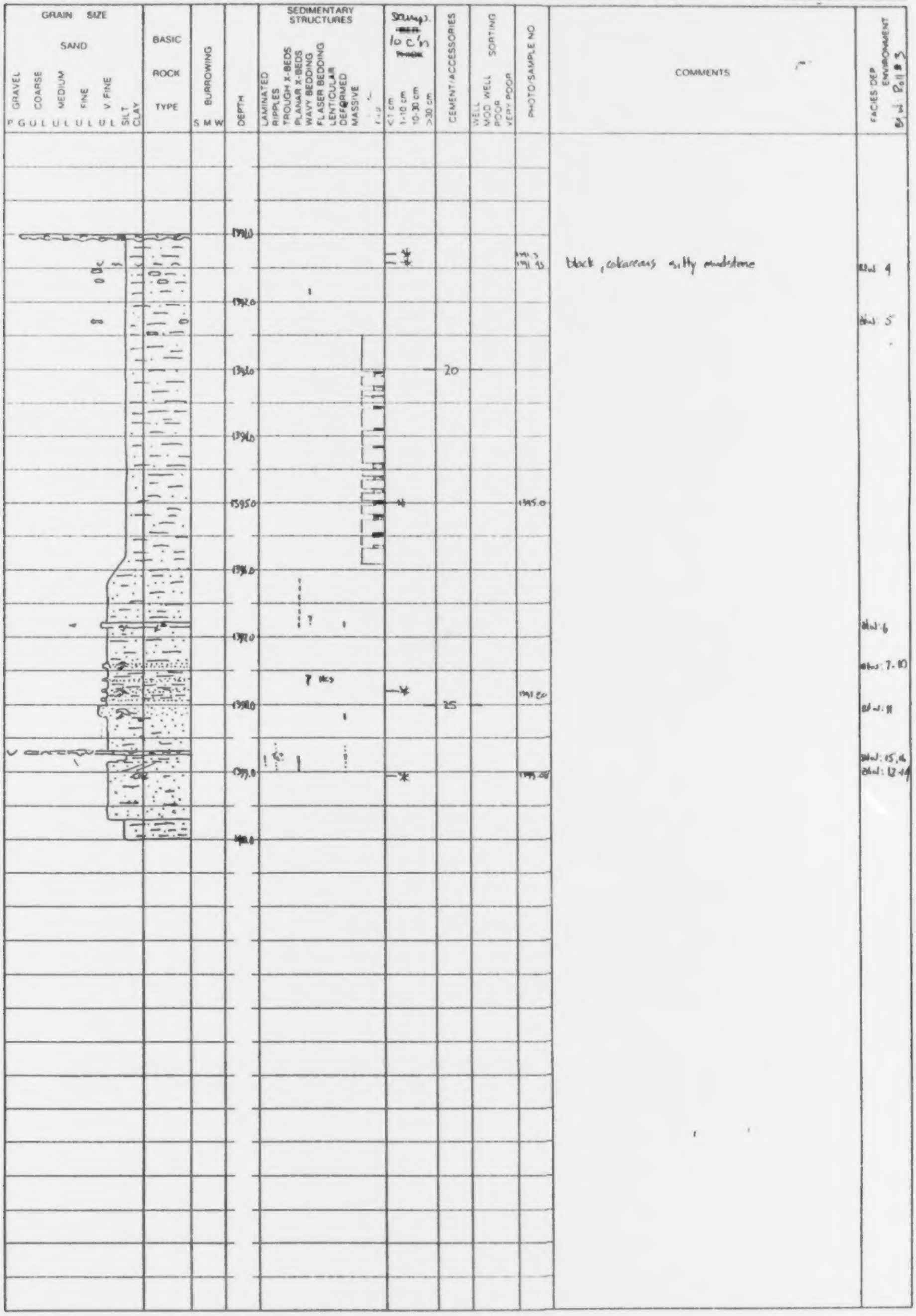
Bld: 31

Bld: 22

Bld: 23

Bld: 24,25

WELL NAME: Texaco Et Al. Buick
FORMATION: Doig
DATE: 02/25/93
LOCATION: d-79-I/94-A-11
CORE INTERVAL: 1391.0 - 1400.0
KB: 711.5



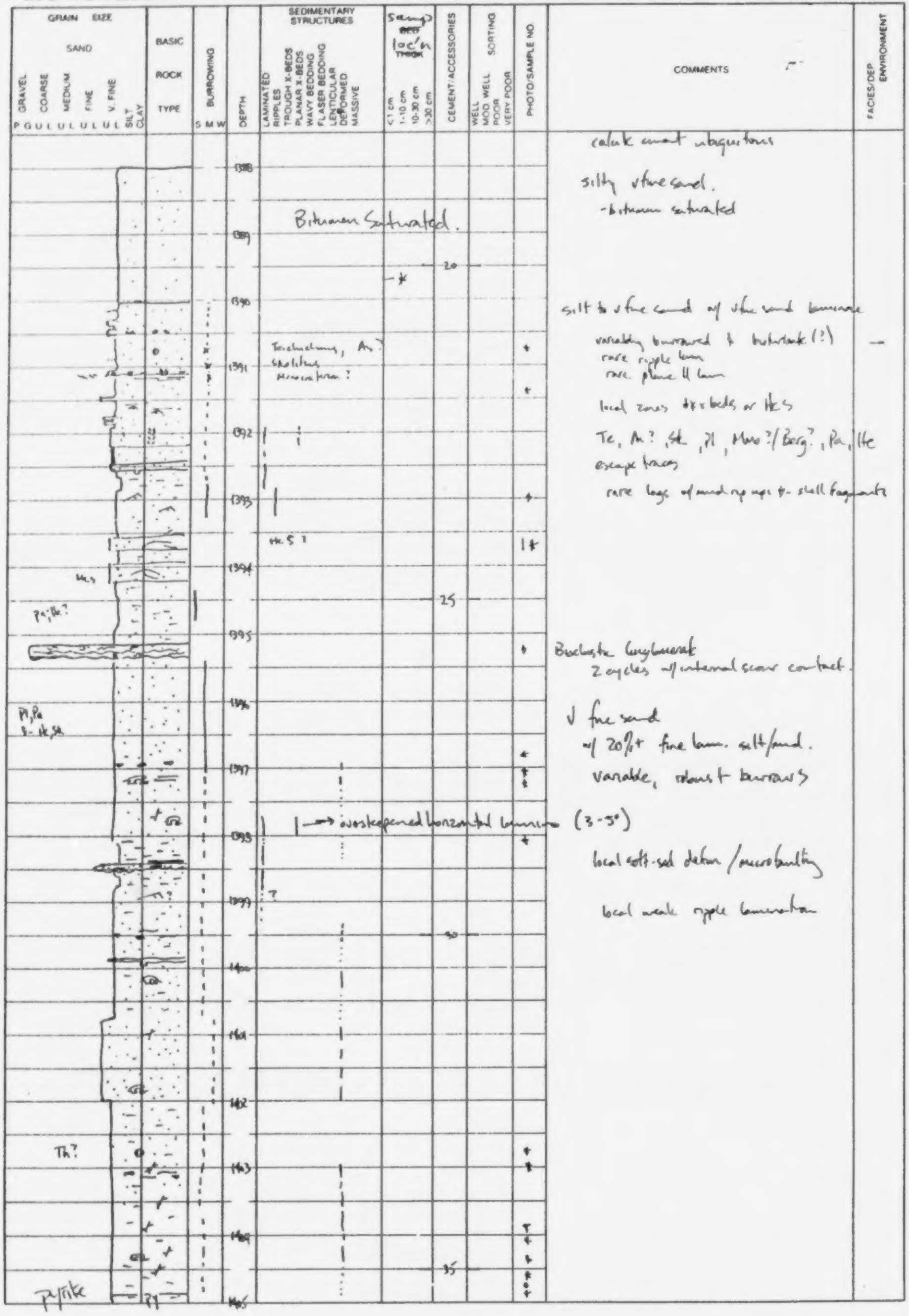
GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
Stungs.
10 c'n
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES DEP. ENVIRONMENT
Bkwl Roll #3
1391.0
1392.0
1393.0
1394.0
1395.0
1396.0
1397.0
1398.0
1399.0
1400.0
20
25
? RCS
1391.5
1391.95
1395.0
1397.80
1399.20
Bkwl: 4
Bkwl: 5
Bkwl: 6
Bkwl: 7-10
Bkwl: 11
Bkwl: 15,16
Bkwl: 12-14

black, calcareous silty mudstone

p1/3

WELL NAME: Esso Gulf Buck d-85-I FORMATION: base HFWY / Dolg DATE: 01/26/94

LOCATION: d-85-I / 94-A-11 CORE INTERVAL: 1388.0 - 1424.4 KB: 723.8


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
Samp loc'n
~~BED THICK~~
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP ENVIRONMENT
1388
1389
1390
1391
1392
1393
1394
1395
1396
1397
1398
1399
1400
1401
1402
1403
1404
1405
Bitumen Saturated.
20
25
30
35
Teichichnus, As?
Skolithos
Macaronichnus?
HCS ?
HCS
Pa, He?
Pl, Pa
+- He, Sk
?
Th?
Pyrite
Py
oversteepened horizontal laminae (3-5°)

calcite cement ubiquitous

silty v fine sand.
-bitumen saturated

silt to v fine sand w/ v fine sand laminae
variably burrowed to bioturbated (?)
rare ripple lam
rare plane ll lam
local zones of x-beds or HCS
Te, As?, Sk, Pl, Mac?/Berg?, Pa, He
escape traces
rare logs of mud rip ups +- shell fragments

Bioclastic Conglomerate
2 cycles w/ internal scour contact.

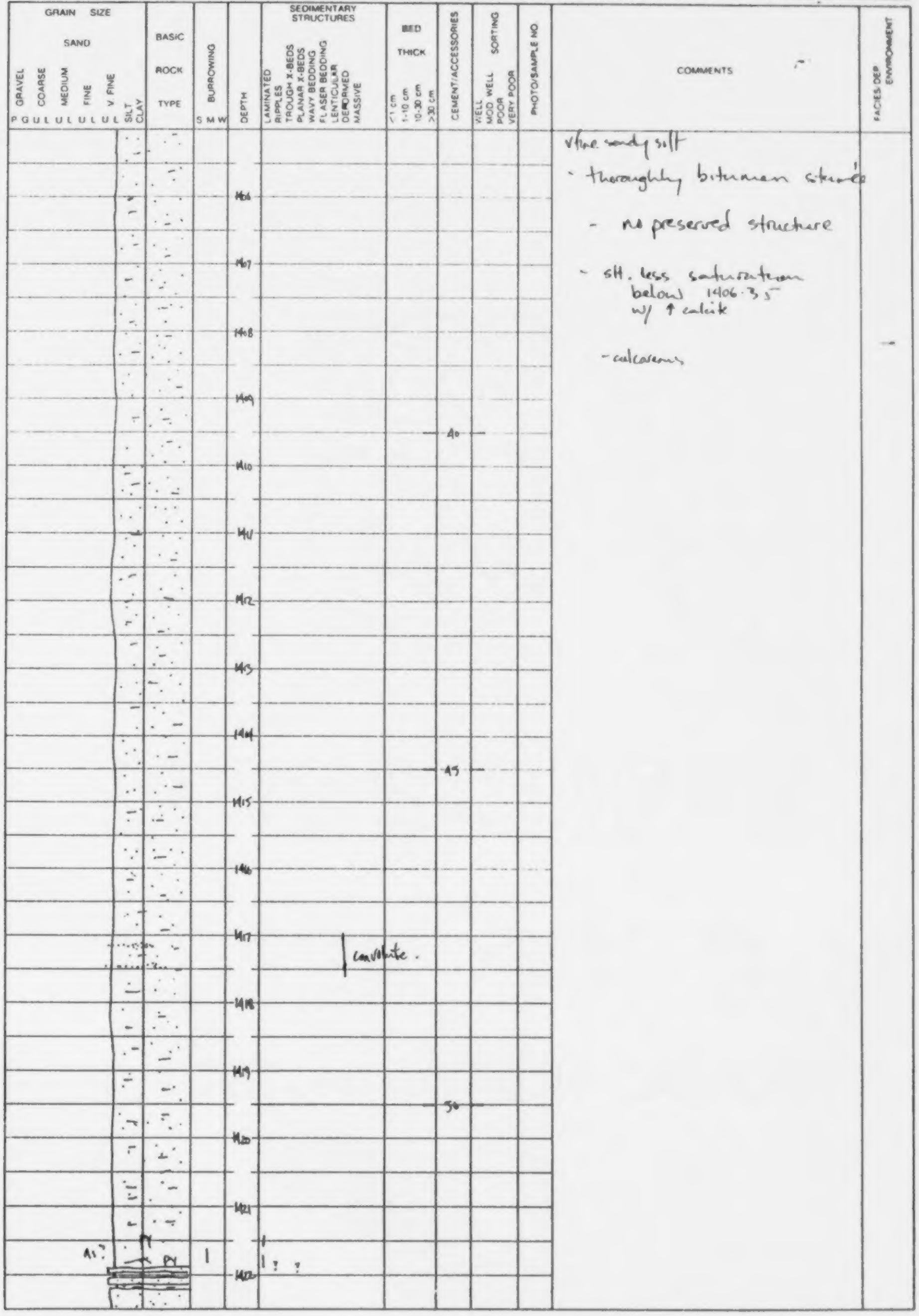
V fine sand
w/ 20%+ fine lam. silt/mud.
variable, robust burrows

local soft-sed defm / microfaulting

local weak ripple lamination

p283

WELL NAME: EssoGulf Buck d-85-I
FORMATION: base HFny / Dol?
DATE: 01/27/94
LOCATION: d-85-I / 94-A-11
CORE INTERVAL: 1398.0 - 1424.4
KB: 723.8


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES DEP ENVIRONMENT
1406
1407
1408
1409
40
1410
1411
1412
1413
1414
45
1415
1416
1417
convolute.
1418
1419
50
1420
1421
Ar?
PY
PY
? ?
1422

vfine sandy silt

- thoroughly bitumen stained

- no preserved structure

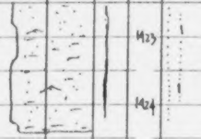
- slt. less saturation below 1406.35 w/ ↑ calcite

- calcareous

p.3A3

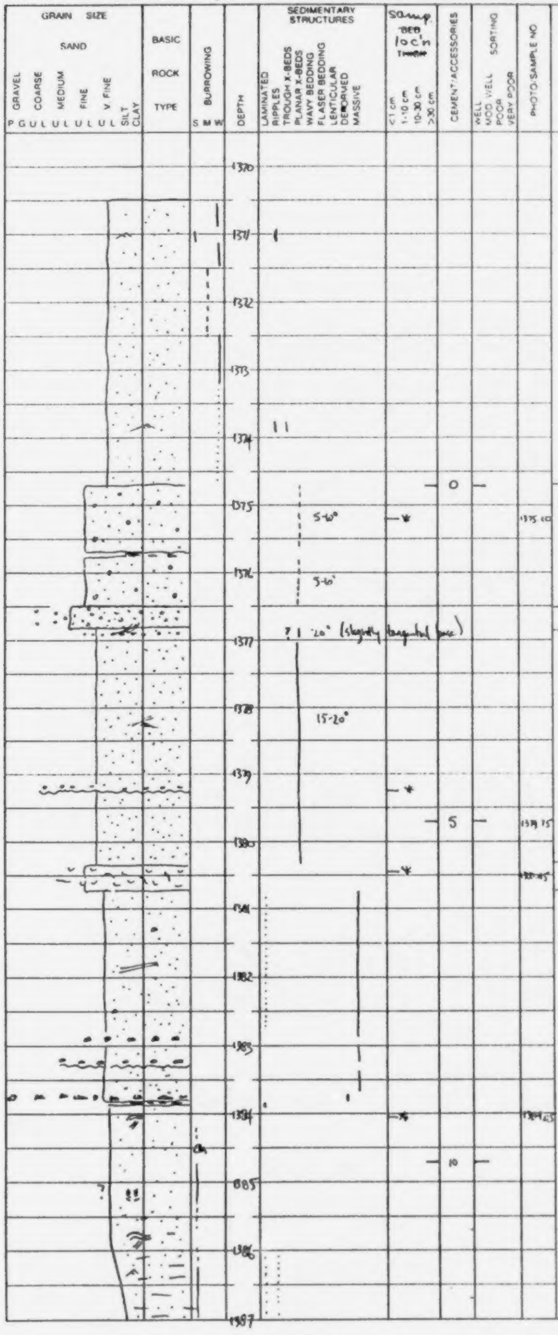
WELL NAME: Esso Gulf Buck d85 I
FORMATION: base Hfwy / Doig
DATE: 01/27/94
LOCATION: d-85-I /94-A-11
CORE INTERVAL: 1389.0 - 1424.4
KB: 723.8

| GRAIN SIZE<br>GRAVEL, SAND (COARSE, MEDIUM, FINE, V FINE), SILT, CLAY<br>P G U L U L U L U L | BASIC ROCK TYPE | BURROWING<br>S M W | DEPTH | SEDIMENTARY STRUCTURES<br>LAMINATED, RIPPLES, TROUGH X-BEDS, PLANAR X-BEDS, WAVY BEDDING, FLASER BEDDING, LENTICULAR, DEFORMED, MASSIVE | BED THICK<br><1 cm, 1-10 cm, 10-30 cm, >30 cm | CEMENT/ACCESSORIES | SORTING<br>WELL, MOD WELL, POOR, VERY POOR | PHOTO/SAMPLE NO | COMMENTS | FACIES/DEP ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|
| A, Pl, He<br>?Ch? | | | 1423<br>1424 | | | | | | sandier interval, moderately burrowed to bioturbate<br>possible form stoned ripples. | |



WELL NAME: Esso Gulf Buick d-86-I FORMATION: Halfway/Doig DATE 03/02/93

LOCATION: d-86-I/94-A-11 CORE INTERVAL: 1370.5 - 1388.6 KB 134.9



GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
samp. loc'n
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD. WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
1370
1371
1372
1373
1374
1375
1376
1377
1378
1379
1380
1381
1382
1383
1384
1385
1386
1387
5-10°
5-10°
? ~20° (slightly tangential base)
15-20°
0
5
10
1375.10
1379.75
1380.45
1384.25

COMMENTS

v.f. silty sandstone
- unit almost completely homogenized
- locally preserved traces of ripple lam
- unit currently beige due to alteration (dolomite?) w/ relict dark grey horizons

Bdw: 7

Bdw: 8

(medium) to fine sand w/ few med-coarse sand grains (RF's)
- v. faint low X lamination locally observed @ 5-10°

fine sand w/ ~20% med-coarse sand sizes

Bdw: 9

fine to v.fine sandstone
- planar tabular cross-bedding @ 15°-20°

Bioclastic unit - lag?
moldic porosity, shell molds up to 3mm long

vfg sand
- predominantly structureless & massive
- faint to low X relict laminations
- few rip up clasts (<4mm)

interbedded vfg silty sand and sandy mud
& minor ripple lamination, & LA lam. +/- HCS
- gen'l fining-down cycle

- chondrites +/- planolites/palaeophycus

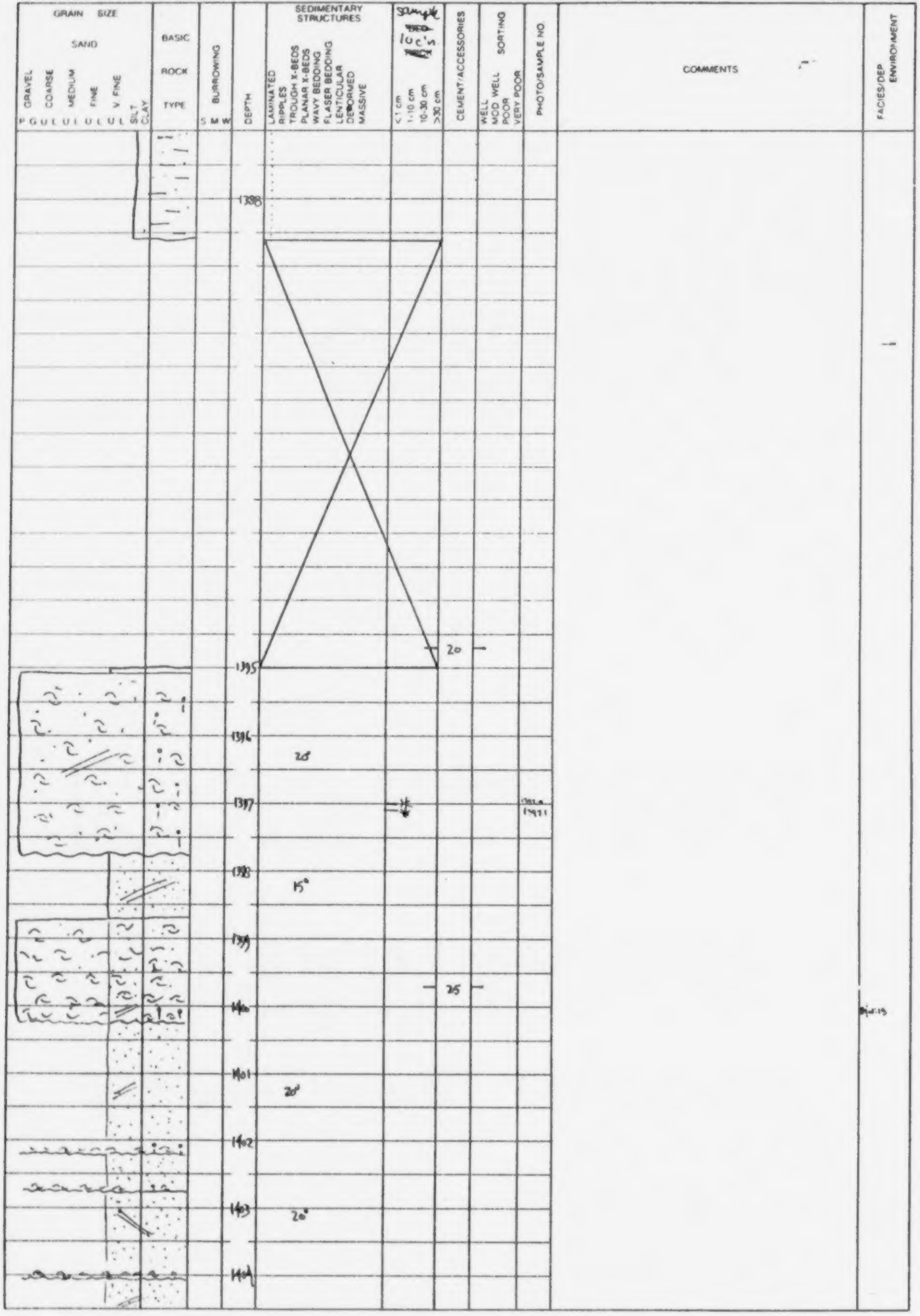
Bdw: 10, 6

Bdw: 12

p2d3

WELL NAME: Esso Gulf Buick d-86-I FORMATION: Doig DATE:

LOCATION: d-86-I /94-A-11 CORE INTERVAL: 1376.5-1388.6 ; 1395.0-1413.2 KB: 734.9

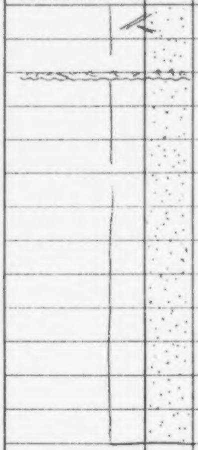


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
sample loc'n
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO.
COMMENTS
FACIES/DEP ENVIRONMENT
1388
20
1395
1396
20°
1397
1398
15°
1399
25
1400
1401
20°
1402
1403
20°
1404

p3f3

WELL NAME: Esso Gulf Bruce d-86-I FORMATION: Doig DATE:

LOCATION: d-86-I / 94-A-11 CORE INTERVAL: 1395.0 - 1413.2 KB: 734.9

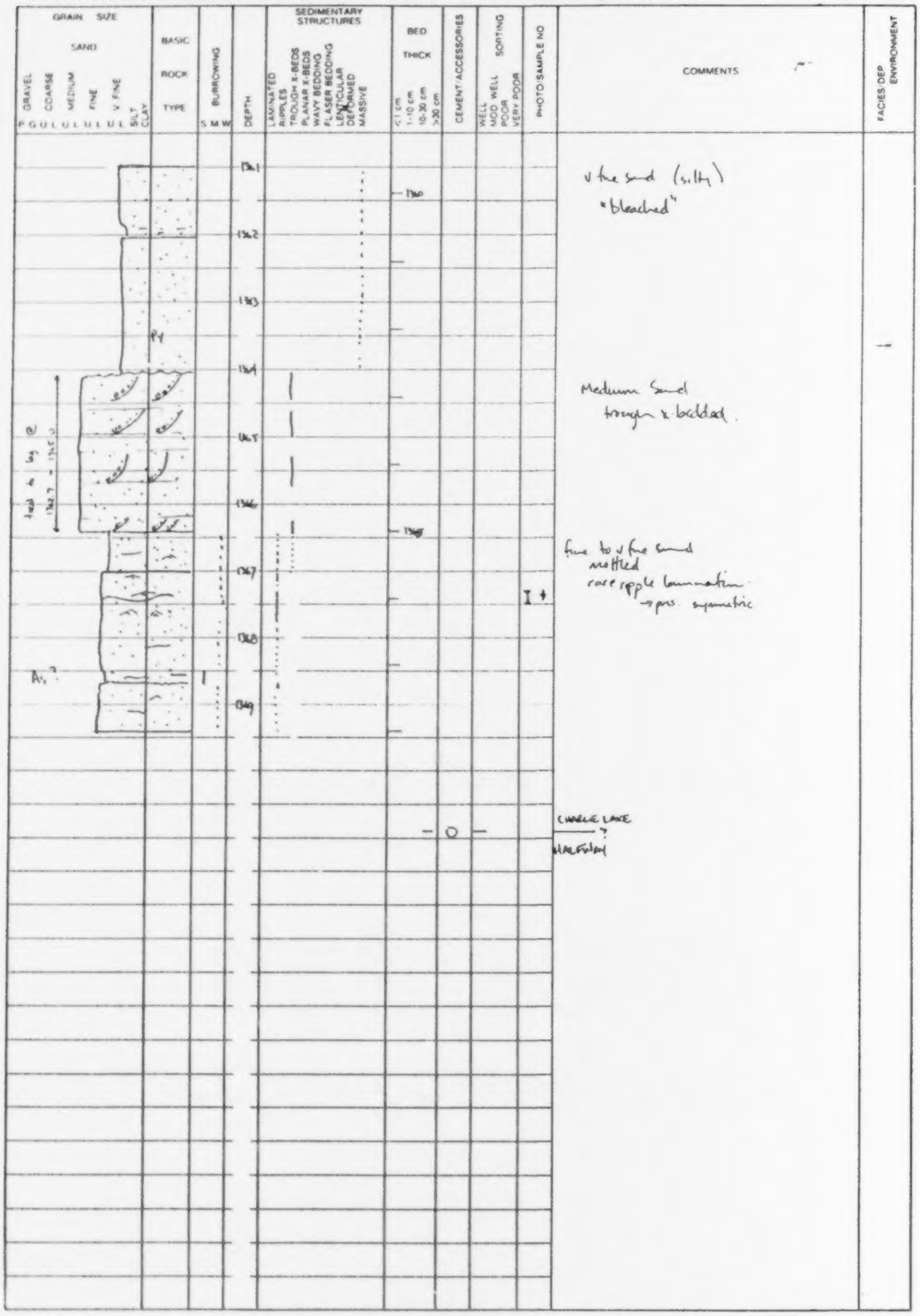


| GRAIN SIZE (GRAVEL, SAND: COARSE, MEDIUM, FINE, V. FINE, SILT, CLAY) | BASIC ROCK TYPE | BURROWING S M W | DEPTH | SEDIMENTARY STRUCTURES | samp 10 ch. ~~BED~~ ~~THICK~~ (<1 cm, 1-10 cm, 10-30 cm, >30 cm) | CEMENT/ACCESSORIES | SORTING (WELL, MOD WELL, POOR, VERY POOR) | PHOTO/SAMPLE NO | COMMENTS | FACIES/DEP ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 10° | 4 | 30 | — | 1404.75 | | |
| | | | 1405 | | | | | | | |
| | | | 1406 | | | | | | | |
| | | | 1407 | | | | | | | |
| | | | 1408 | | | | | | | |
| | | | 1409 | | | | | | | |
| | | | | | | 35 | | | | |
| | | | 1410 | | | | | | | |
| | | | 1411 | | | | | | | |
| | | | 1412 | | | | | | | |

WELL NAME: Esso Gulf Buick d-A96-I FORMATION: Charlie Lake +/- HFNY DATE: 01/24/94

1357.6 - 1365.0

LOCATION: d-A96-I /94-A-11 CORE INTERVAL: 1361.0 - ~~1369.4~~ KB: 735.1


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP ENVIRONMENT
1361
1362
1363
1364
1365
1366
1367
1368
1369
1360
1365
Py
faded in log @ 1362.7 - 1365.0
As ?
I +
CHARLIE LAKE
?
HALFWAY

v fine sand (silty)
"bleached"

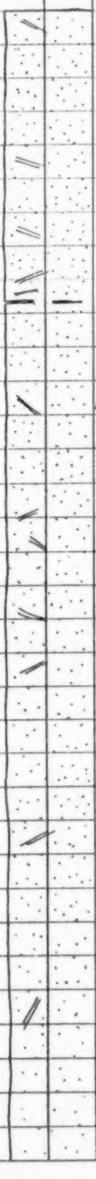
Medium Sand
trough x bedded.

fine to v fine sand
mottled
rare ripple lamination
→ poss. symmetric

1 of 2

WELL NAME: Esso Gulf Buick d-96-I FORMATION: DOIG DATE 03/03/93

LOCATION: 2z/ d-96-I /94-A-11 CORE INTERVAL: 1389.0 - 1416.0 KB: 735.1



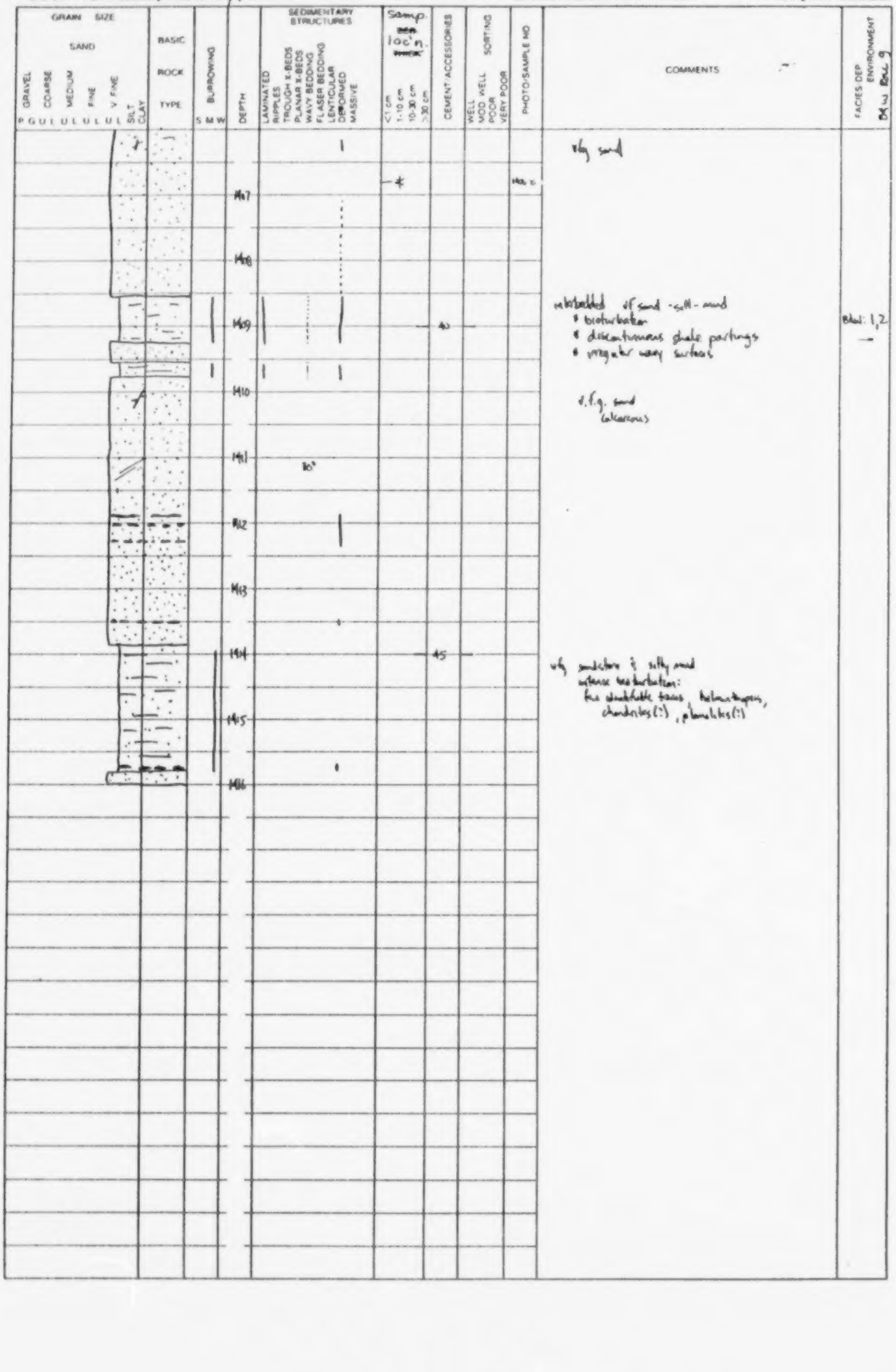
GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE

| DEPTH | BURROWING S M W | SEDIMENTARY STRUCTURES (LAMINATED, RIPPLES, TROUGH X-BEDS, PLANAR X-BEDS, WAVY BEDDING, FLASER BEDDING, LENTICULAR, DEFORMED, MASSIVE) | sample location (<1 cm, 1-10 cm, 10-30 cm, >30 cm) | CEMENT ACCESSORIES | SORTING (WELL, MOD WELL, POOR, VERY POOR) | PHOTO SAMPLE NO | COMMENTS | FACIES/DEP. ENVIRONMENT [illegible] |
|---|---|---|---|---|---|---|---|---|
| 1389 | | 20° | | 20 | | | vfg sandstone<br>• variable bitumen stain<br>• predominantly structureless<br>• locally depositional structure preserved by cementation pattern<br>→ vertical // bioturbation | |
| 1390 | | | | | | | | |
| 1391 | | 15° | | | | | | |
| 1392 | | 20° | | | | | | |
| 1393 | | 25-30°?<br>15° | | | | | | |
| 1394 | | | | 25 | | | | |
| 1395 | Pl.0/64? | 20° | → | | | 1395.75 | | |
| 1396 | | 15°<br>35° | | | | | | |
| 1397 | | | | | | | | |
| 1398 | | ~25°<br>15° | | | | | | Bbd:24 |
| 1399 | | | | 30 | | | | |
| 1400 | | | | | | | | |
| 1401 | | ? 35°/15° | | | | | | |
| 1402 | | | | | | | | |
| 1403 | | 35° | | | | | | Bbd: 0 |
| 1404 | | | → | 35 | | 1404.2 | | |
| 1405 | | | | | | | | |
| 1406 | | | | | | | | |

2.62

WELL NAME: Esso Gulf Buick d-A96-I FORMATION: Doig DATE: 03/03/93

LOCATION: 202/d-96-I/94-A-11 CORE INTERVAL: 1389.0 - 1416.0 KB: 735.1



vfg sand

interbedded vf sand - silt - mud
- bioturbation
- discontinuous shale partings
- irregular wavy surfaces

v.f.g. sand
calcareous

vfg sandstone & silty sand
intense bioturbation:
few identifiable traces, helminthopsis,
chondrites(?), planolites(?)

p.1 of 3

WELL NAME: Imp. Gulf Beach d-B96-I

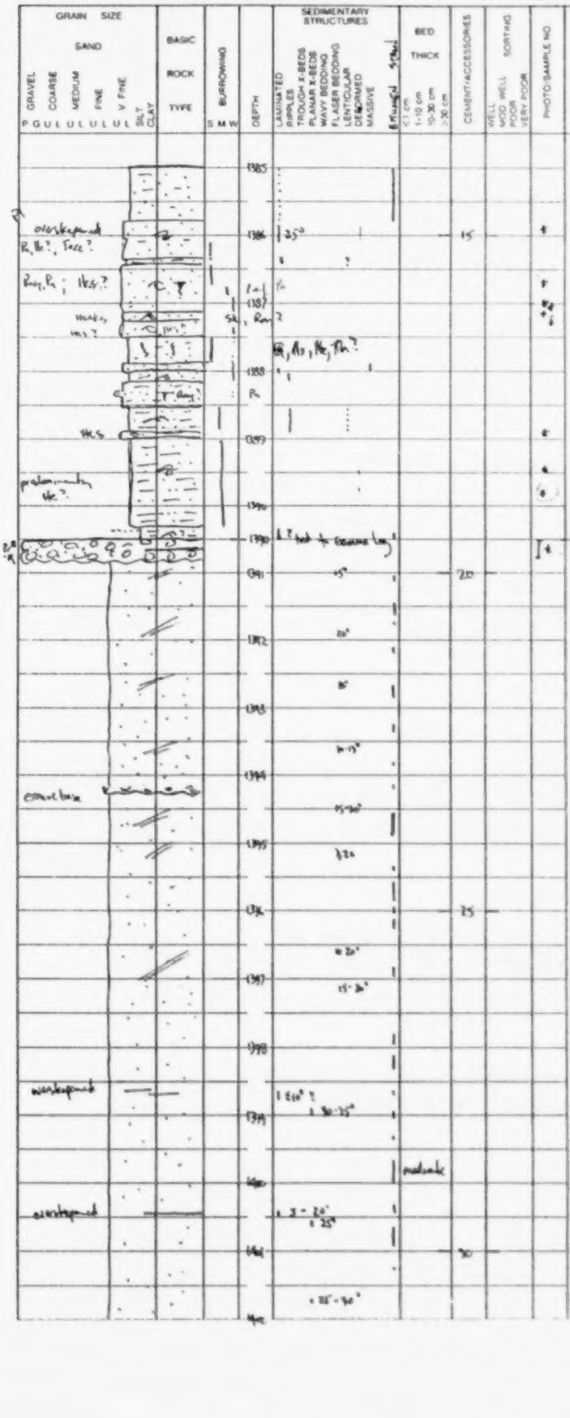
FORMATION: basal HFWY - Doig

DATE: 01/20/94

LOCATION: 203/d-96-I/94-A-11

CORE INTERVAL: 1384.5 1385.0 - 1426.3 1426.8

KB: 735.4


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
Bitumen stained
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
1385
1386
1387
1388
1389
1390
1391
1392
1393
1394
1395
1396
1397
1398
1399
1400
1401
1402
oversteepened
R, Hc?, Terc?
Rsy, Pa ; Hcs?
Hcs?
Hcs
predominantly Hc?
erosive base
oversteepened
oversteepened
25°
Pa
Sk, Rsy ?
R, As, Hc, Th?
Pa
L? bed to coarse lag?
15°
20°
15°
10-15°
15-20°
≥20
≤20°
15-20°
≤10° ?
≤ 20-25°
≤ 20°
≤ 25°
≤ 25-30°
moderate
15
20
25
30

COMMENTS

v fine sand w/ silt interbeds

variably burrowed to locally bioturbate

possible thin starved ripples

Hcs

local convolute laminations and oversteepened bedding

L. HFWY F.S.

v. coarse cobbles

Doig 2 intervals,

chaotic

clast support

V. fine to fine sand (upper v. fine)

abundant bitumen stain

med-high ∠ x-beds @ 15° ± 5°

irregular silty/mud stringers to base

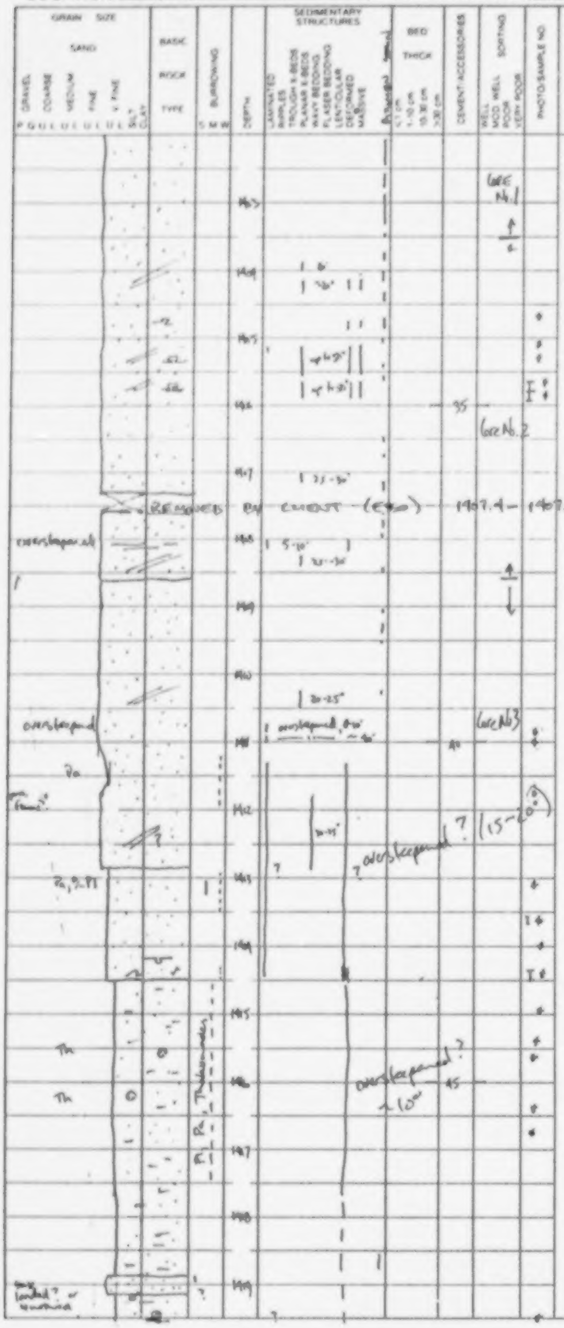
oversteepened?

FACIES/DEP ENVIRONMENT

p. 2 of 3

WELL NAME: Imp. Gulf Brock d-B96-I FORMATION: Dev. DATE: 01/31/94

LOCATION: 203/d-96-I /94-A-4 CORE INTERVAL: 1385.0 - 1426.8 KB: 735.4



GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO.
1403
1404
1405
1406
1407
1408
1409
1410
1411
1412
1413
1414
1415
1416
1417
1418
1419
Core No. 1
Core No. 2
Core No. 3
oversteepened
oversteepened
oversteepened ?
oversteepened ?
~10°
(15-20°)
35
40
45
Th
Th
R. Thalassinoides

REMOVED BY CLIENT (E&O) 1407.4 – 1407.6 (1407.29-1407.6 measured on core)

COMMENTS

1402.0, 1402.50 Fractures @ 45°
↳ cement stained
↳ fracture to bedding contact.

vfine to upper vfine sand
gen'ly mod calc.

L. vfine sand.
vert. fracture.

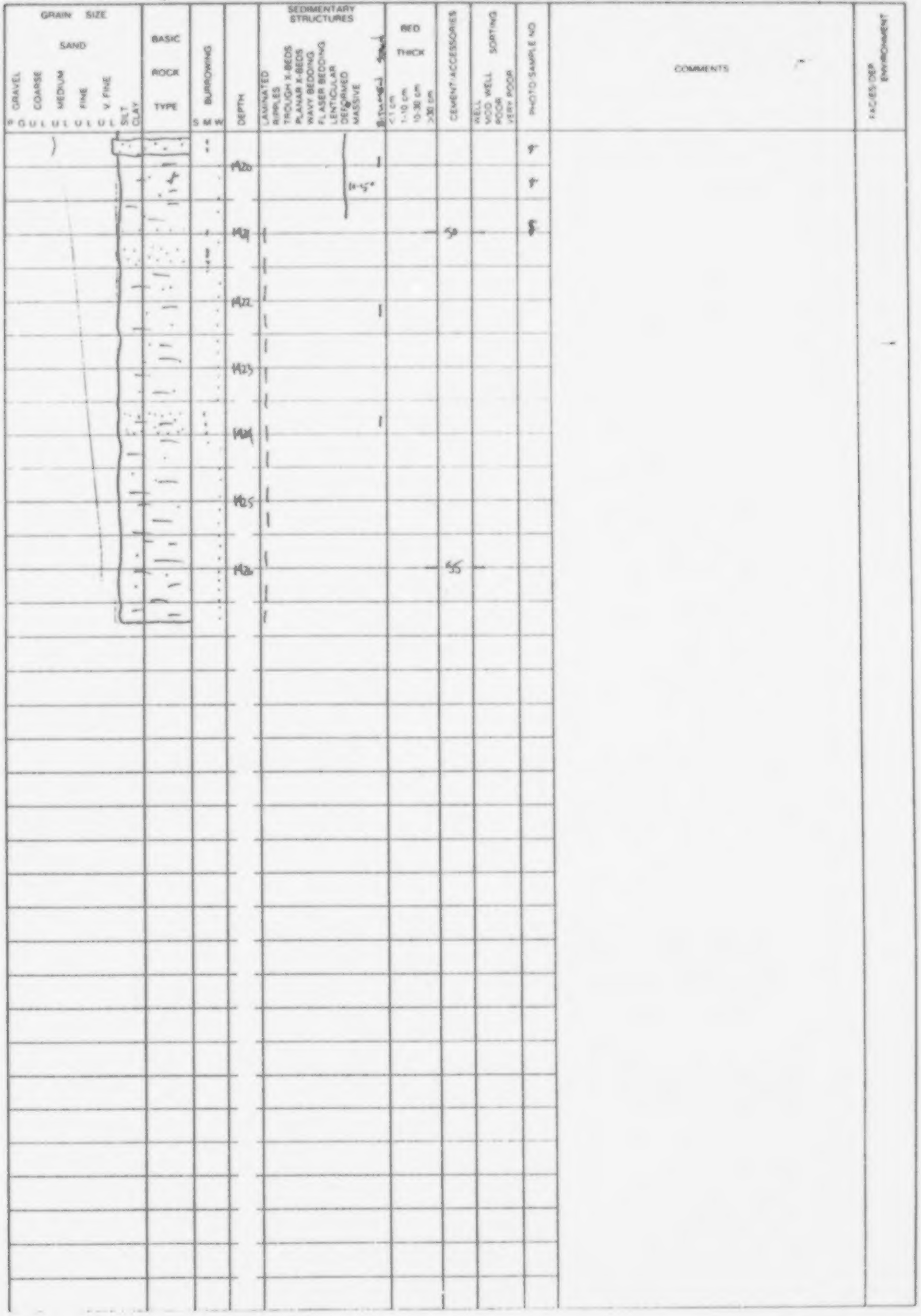
L. vfine sand w/ 15-30% silt/mud.
oversteepened shale laminae (10°)

v fine sandy silt w/ ≤ 30% sand
variably burrowed
sands may be internally mass
or Tcd
convolute laminations rare
loaded bases on some sands.

FACIES DEP. ENVIRONMENT

WELL NAME: W.P., Gulf Bruce d-B96-I FORMATION: Doig DATE: 3 of 3 01/41/94

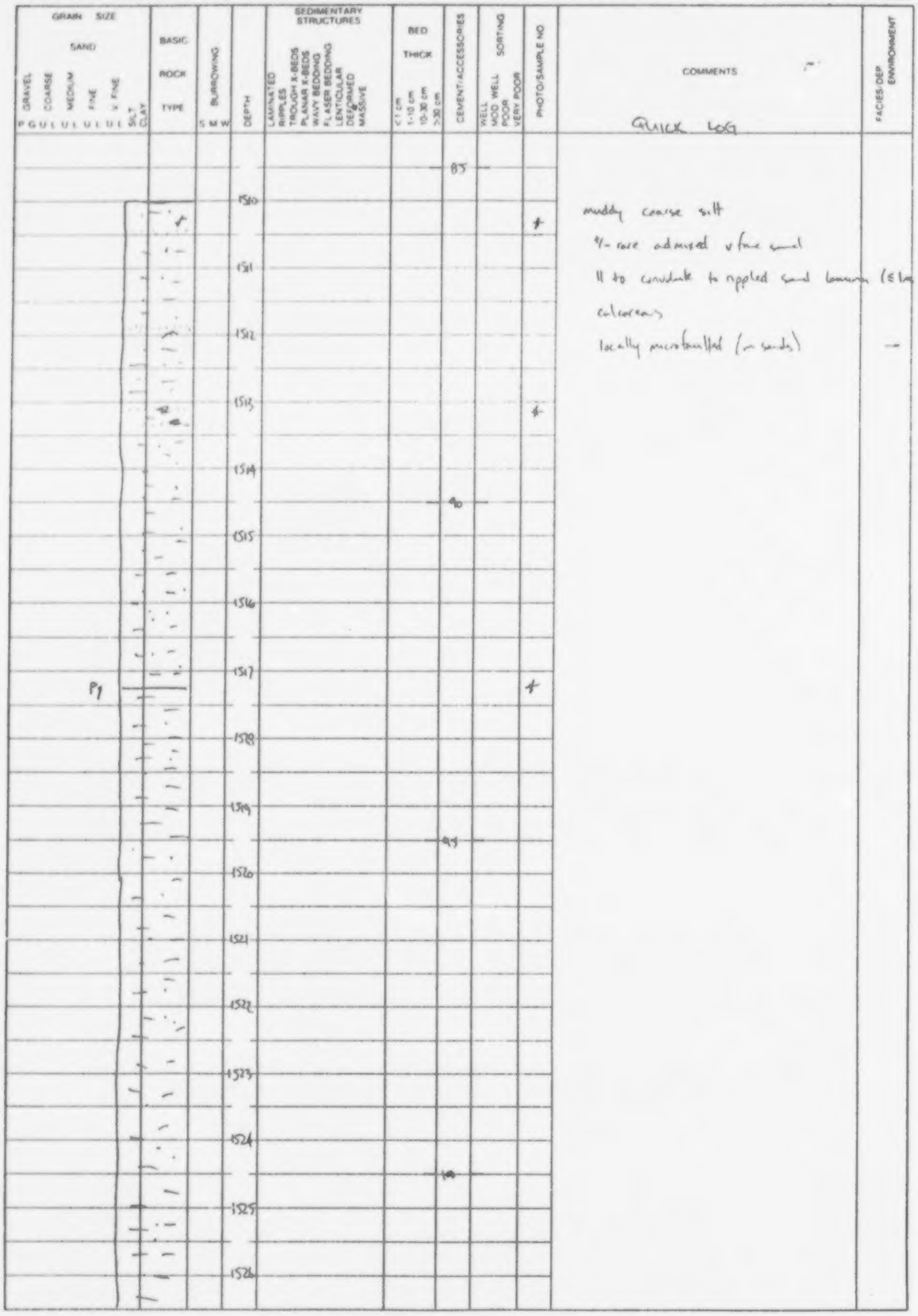
LOCATION: 203 / d-96-I /94-A-11 CORE INTERVAL: 1385.0 - 1426.B KB: 735.4


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
Bitumen stained
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD. WELL
POOR
VERY POOR
PHOTO/SAMPLE NO.
COMMENTS
FACIES/DEP. ENVIRONMENT
1420
10-15°
1421
50
1422
1423
1424
1425
1426
55

plot 2

WELL NAME: Dome CDA Buick d-52-J FORMATION: MONTNEY DATE: 02/02/94

LOCATION: d-52-J/ 94-A-11 CORE INTERVAL: 1510.0 - 1528.2 KB: 759.4 m


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP ENVIRONMENT
85
1510
1511
1512
1513
1514
90
1515
1516
1517
Py
1518
1519
95
1520
1521
1522
1523
1524
00
1525
1526

QUICK LOG

muddy coarse silt

w/ rare admixed v fine sand

ll to convolute to rippled sand laminae (≤1cm

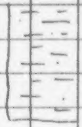
calcareous

locally microfaulted (in sands)

p 2 of 2

WELL NAME: Dome CDA Buick d-52-J FORMATION: MONTNEY DATE: 02/02/94

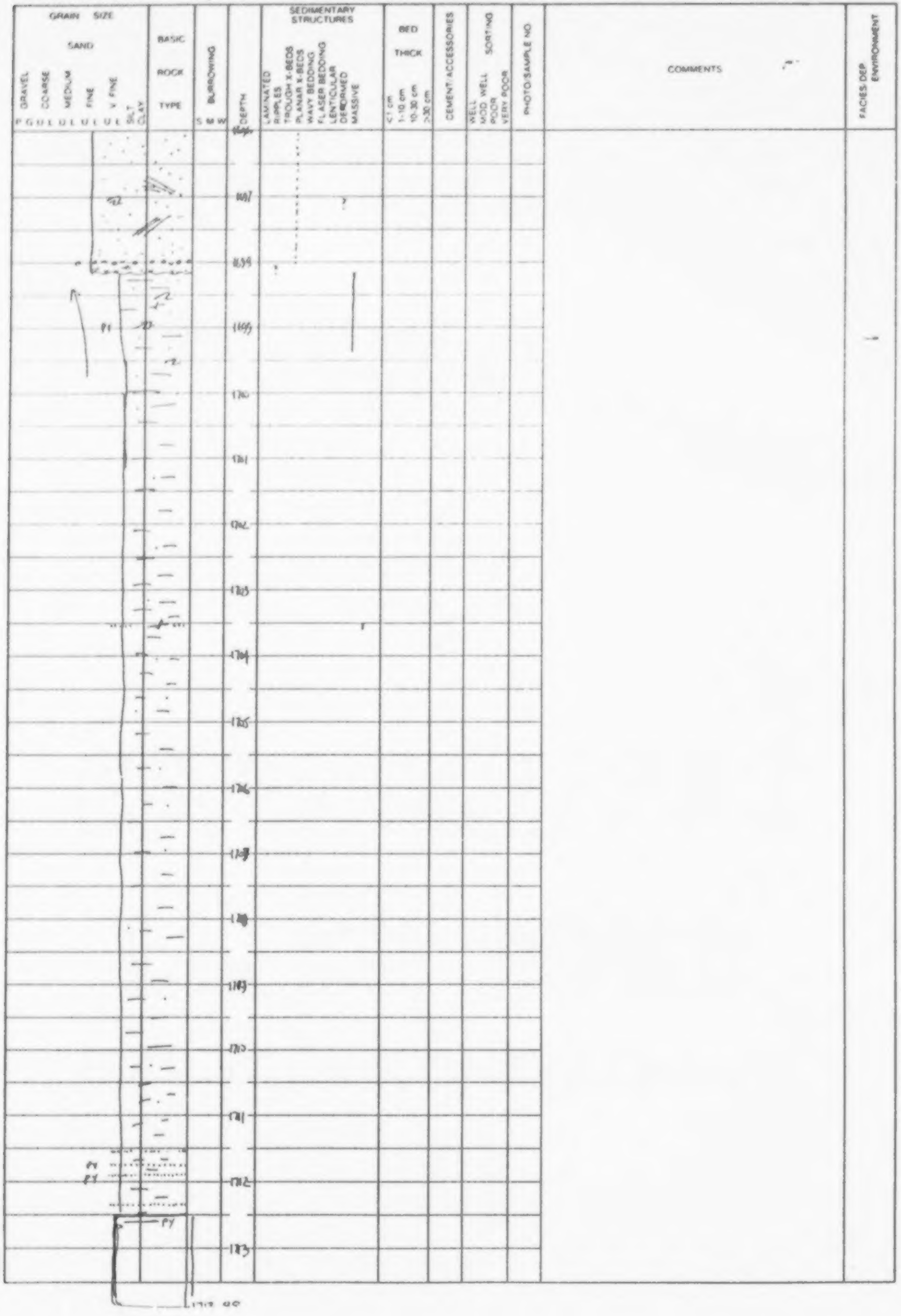
LOCATION: d-52-J / 94-A-11 CORE INTERVAL: 1510.0 - 1528.2 KB: 759.4



| GRAIN SIZE<br>SAND<br>GRAVEL COARSE MEDIUM FINE V FINE SILT CLAY<br>P G U L U L U L U L | BASIC ROCK TYPE | BURROWING<br>S M W | DEPTH | SEDIMENTARY STRUCTURES<br>LAMINATED<br>RIPPLES<br>TROUGH X-BEDS<br>PLANAR X-BEDS<br>WAVY BEDDING<br>FLASER BEDDING<br>LENTICULAR<br>DEFORMED<br>MASSIVE | BED THICK<br><1 cm<br>1-10 cm<br>10-30 cm<br>>30 cm | CEMENT/ACCESSORIES | SORTING<br>WELL<br>MOD WELL<br>POOR<br>VERY POOR | PHOTO SAMPLE NO | COMMENTS | FACIES/DEP ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | 1527 | | | | | | | |
| | | | | | | | | | | |
| | | | 1528 | | | | | | | |

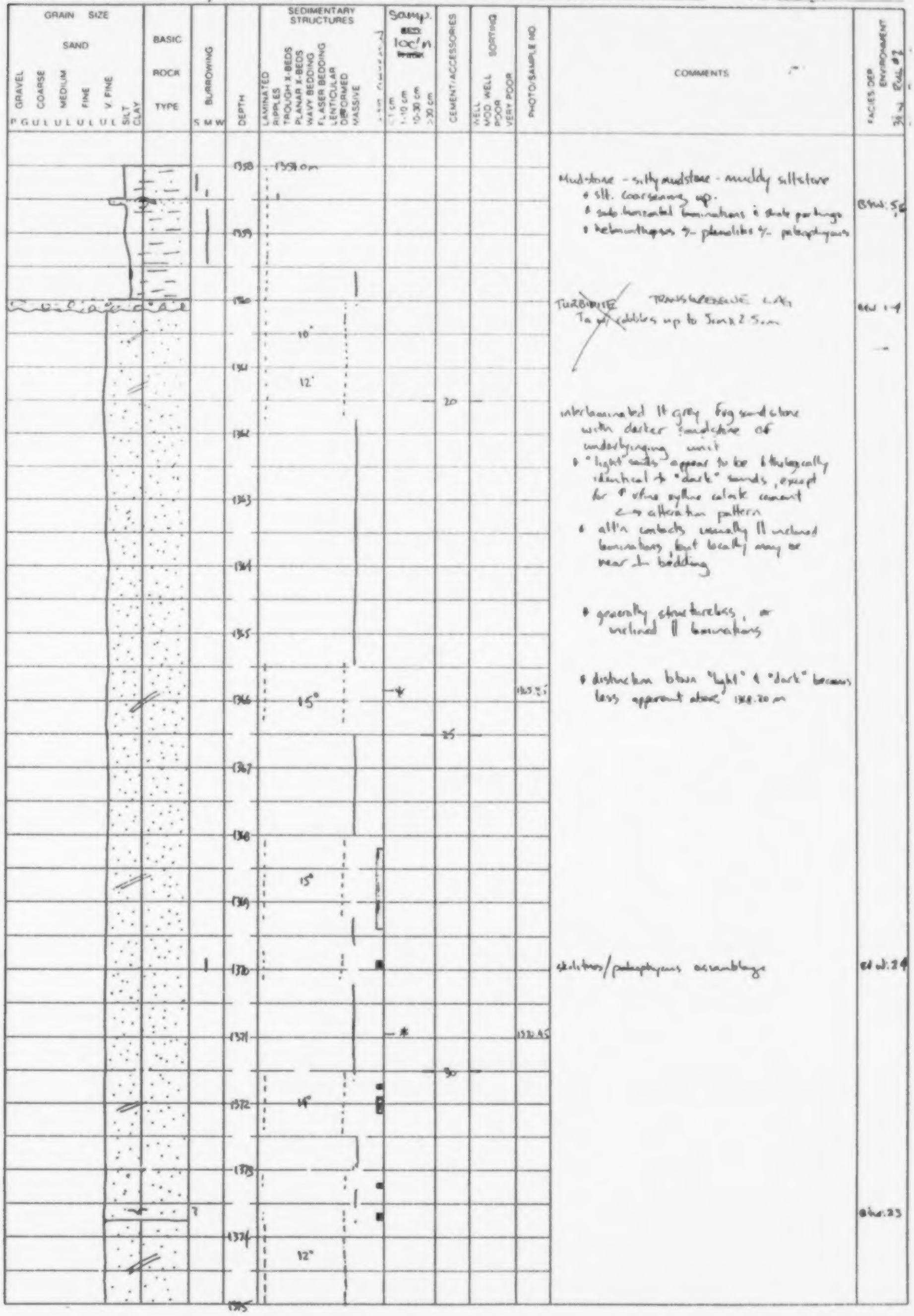
WELL NAME: Czar W. Calice 6-64-I FORMATION: Doig DATE: June 3rd/94

LOCATION: 6-64-I / 94-A-12 CORE INTERVAL: 1696.0 - 1713.88 KB: 853.2


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD. WELL
POOR
VERY POOR
PHOTO/SAMPLE NO.
COMMENTS
FACIES DEP. ENVIRONMENT
1696
1697
1698
1699
1700
1701
1702
1703
1704
1705
1706
1707
1708
1709
1710
1711
1712
1713
PY
PY
PY
PY
1713.00

1 of 2

WELL NAME: Esso Sun Buick d-06-A
FORMATION: Doig
DATE: 03/02/93
LOCATION: d-06-A/94-A-14
CORE INTERVAL: 1357.0 - 1385.0 ~~1358.0 - 1386.0~~
KB: 105.6


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
Samp. loc'n
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES DEP ENVIRONMENT
1358
1358.0 m
1359
1360
10°
1361
12°
20
1362
1363
1364
1365
1366
15°
1365.35
25
1367
1368
15°
1369
1370
1371
1371.45
30
1372
14°
1373
1374
12°
1375

Mudstone - silty mudstone - muddy siltstone
- slt. coarsening up.
- sub-horizontal laminations & shale partings
- helminthopsis +/- planolites +/- palaeophycus

BSW:5

~~TURBIDITE~~ TRANSGRESSIVE LAG
Ta w/ cobbles up to 5cm x 2.5cm

RSW:1-4

interlaminated lt grey f.g. sandstone with darker sandstone of underlying unit
- "light" sands appear to be lithologically identical to "dark" sands, except for fine sylline calcite cement → alteration pattern
- alt'n contacts usually ∥ inclined laminations but locally may be near ⊥ bedding

- generally structureless, or inclined ∥ laminations

- distinction btwn "light" & "dark" becomes less apparent above 1368.20 m

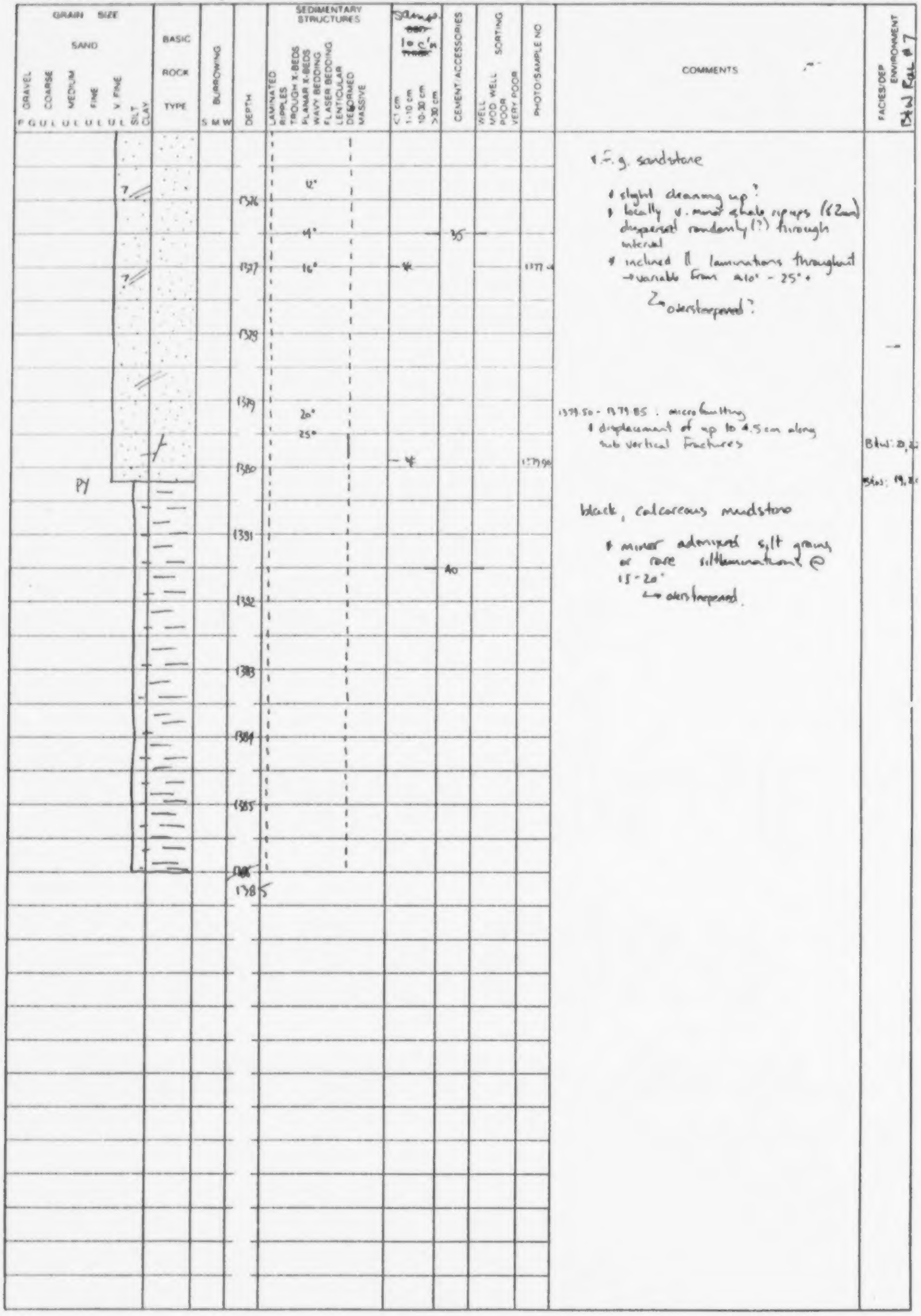
skolithos/palaeophycus assemblage

Ed sl:24

Shs:23

2 of 2

WELL NAME: Esso [illegible] Buick d-06-A
FORMATION: Doig
DATE: 03/02/93
LOCATION: d-06-A/94-A-14
CORE INTERVAL: 1358.0 - 1386.0
KB: 705.6


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
Samp. 1 c'n
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD. WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP ENVIRONMENT
B&W Roll #7
?
?
12°
1376
14°
35
1377
16°
1377.4
1378
1379
20°
25°
1380
1379.90
PY
1381
40
1382
1383
1384
1385
1386
1385
Bkw: 20,2
Bkw: 19,2

v.f.g. sandstone

- slight cleaning up?
- locally v. minor shale ripups (≤2mm) dispersed randomly (?) through interval
- inclined ‖ laminations throughout → variable from ≈10° - 25°+
  ↳ oversteepened?

1379.50 - 1379.85: microfaulting
- displacement of up to 4.5 cm along sub vertical fractures

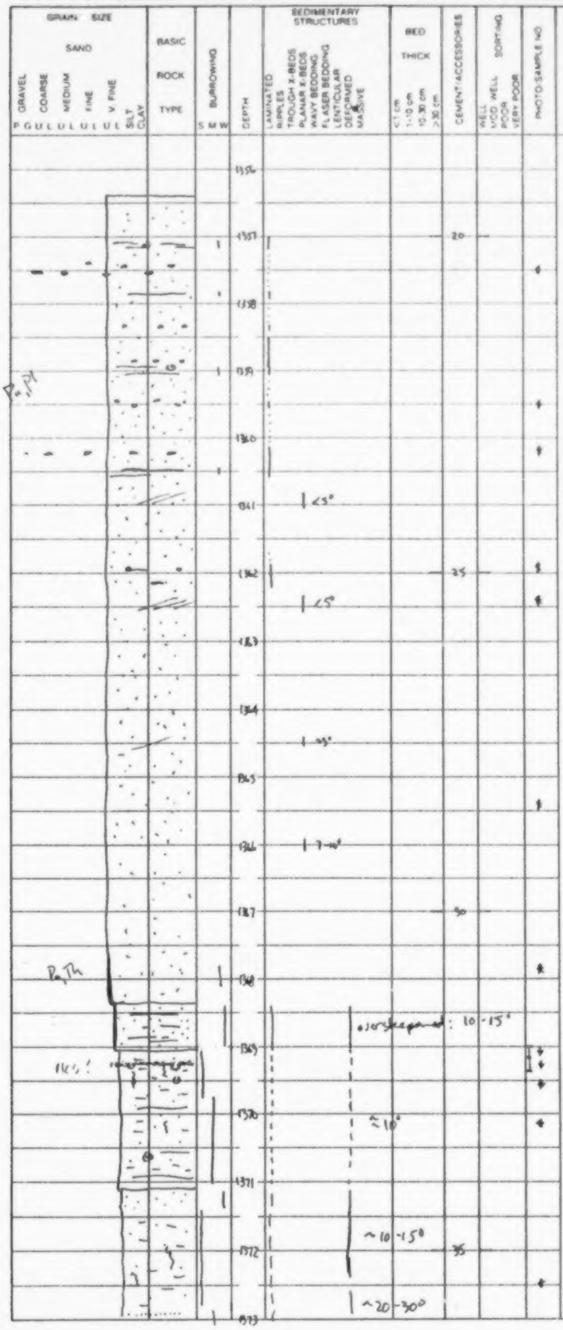
black, calcareous mudstone

- minor admixed silt grains or rare silt laminations @ 15-20°
  ↳ oversteepened.

p. 1 of 2

WELL NAME: Esso Gulf Buck 2-26-A    FORMATION: Doig    DATE 01/31/94

LOCATION: a-26-A /94-A-14    CORE INTERVAL: 1355.4 - 1378.6    KB 705.6


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD. WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
1356
1357
1358
1359
1360
1361
1362
1363
1364
1365
1366
1367
1368
1369
1370
1371
1372
1373
20
25
30
35
Pa, Pl
Pa, Th
Hcs?
<5°
<5°
~25°
7-10°
oversteepened: 10-15°
~10°
~10-15°
~20-30°

COMMENTS

FACIES/DEP. ENVIRONMENT

v. fine to Upper v fine sand

rare zones of 15-30% shale laminae

zones w/ mud "clasts" or "balls"
→ lie in plane of bedding
→ may thin to nothing in bedding plane

some ↓ A x bedding

v. fine sand, < 5% silt/mud
burrowed; Pl, Pa, Sk?

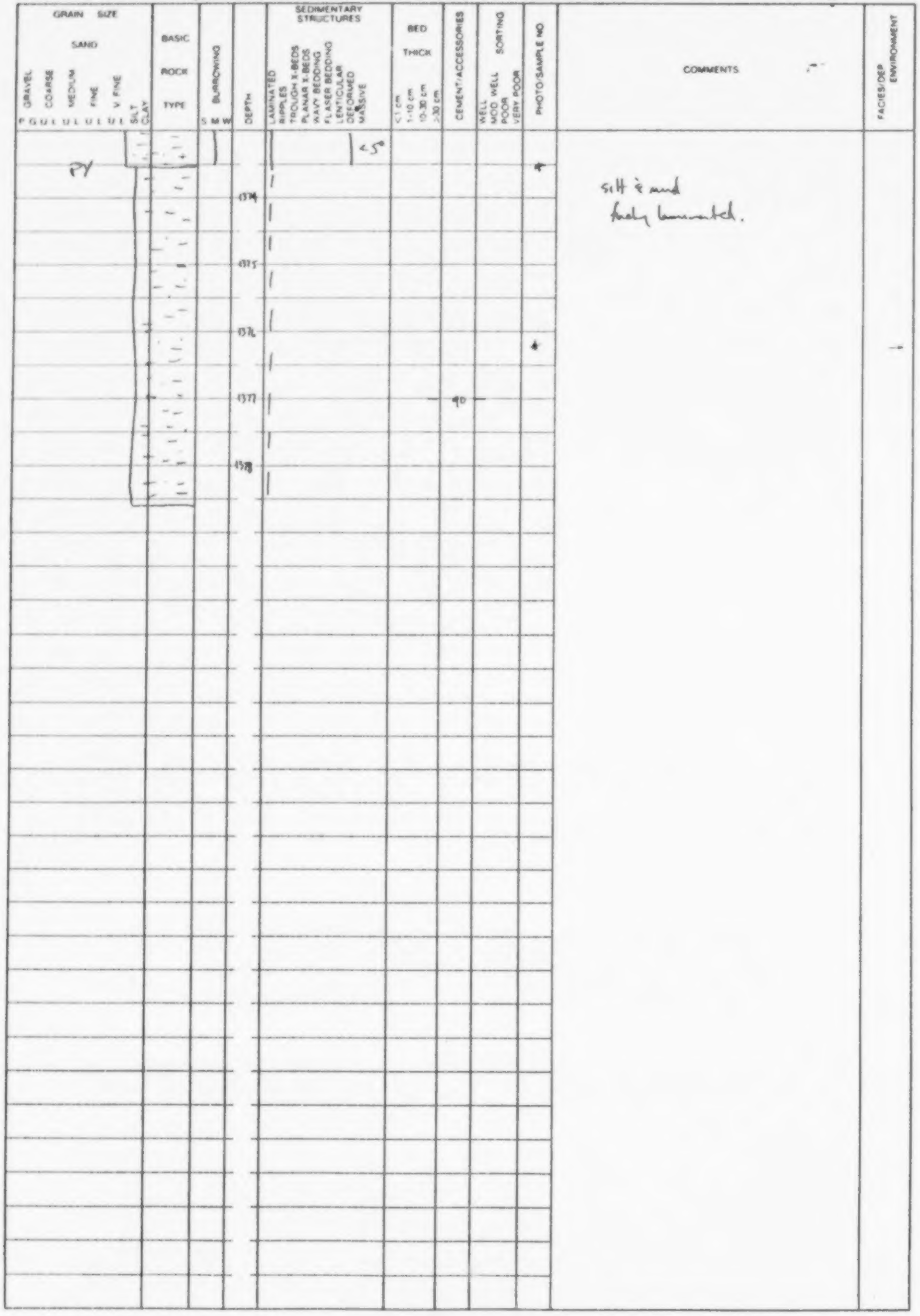
v. fine sand, 10-30% silt/mud
burrowed to bioturbated: Pa, Th
shale laminae <1mm to several mm
(aggregates up to 1.5-2.0 cm ?)
oversteepened @ ≈ 10°

Sandy silt w/ 15-30% v. fine sand
oversteepened @ 10-15°

traces indistinct but horizontal elements
Pl, Pa, Hc?/Asterosoma?

p2f2

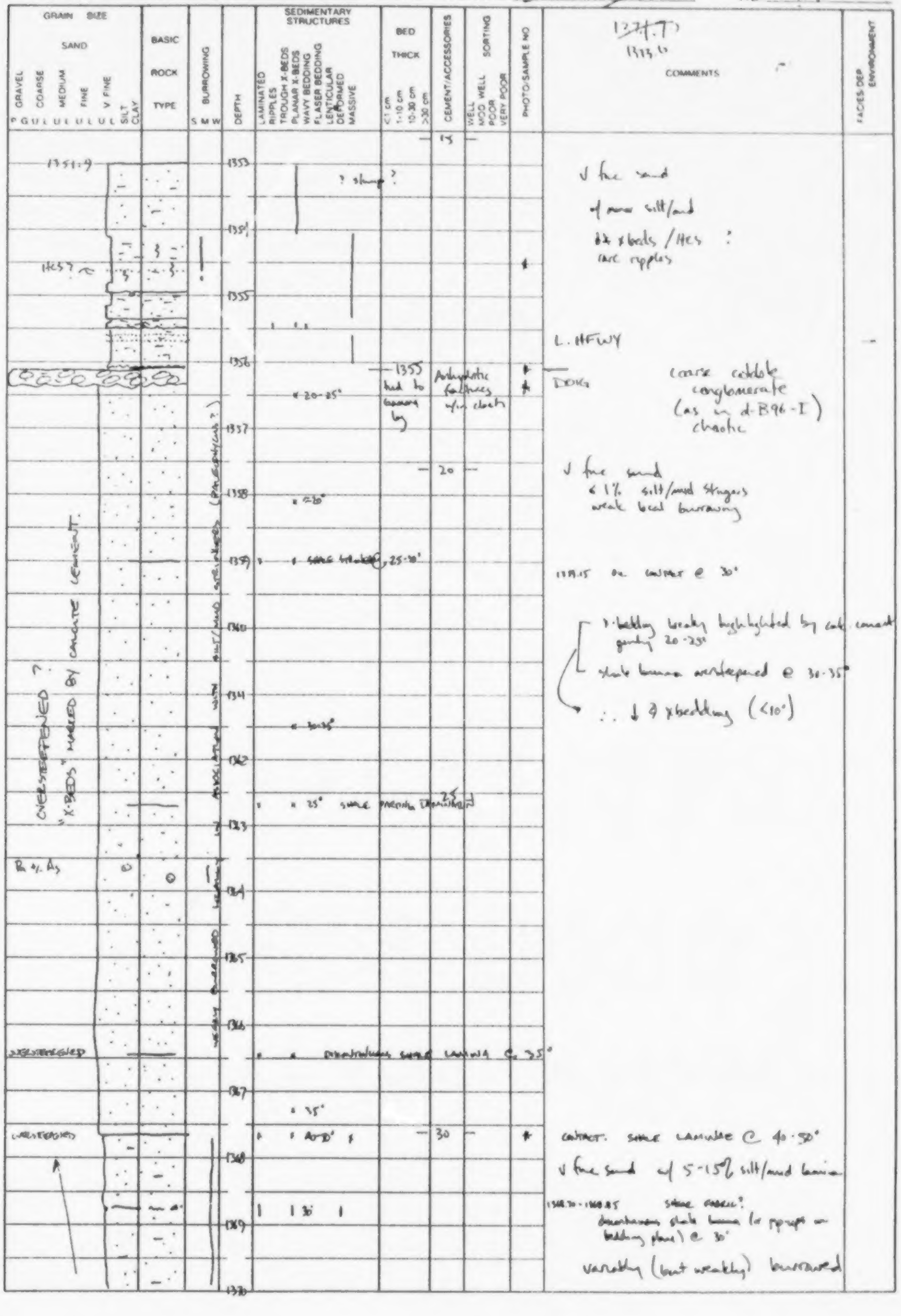
WELL NAME: Esso Gulf Buick a-26-A
FORMATION: Doig
DATE: 02/01/94
LOCATION: a-26-A/94-A-14
CORE INTERVAL: 1356.4 - 1378.6
KB: 703.6


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP ENVIRONMENT
<5°
PY
1374
1375
1376
1377
90
1378

silt c̄ mud
finely laminated.

p 1 of 2

WELL NAME: Esso Gulf Buick d-35-A
FORMATION: Doig (4-Hfwy)
DATE: FEB 1st /84
LOCATION: d-35-A /94-A-14
CORE INTERVAL: ~~1353.0~~ 1351.9 - ~~1375.0~~
KB: 679.9


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES DEP ENVIRONMENT
1351.9
HCS?
1353
1354
1355
1356
1357
1358
1359
1360
1361
1362
1363
1364
1365
1366
1367
1368
1369
1370
? slump?
15
~20-25°
1355 had to gamma log
Anhydritic features w/in clasts
20
~20°
shale break 25-30°
30-35°
25° shale parting (laminated)
25
OVERSTEEPENED ?
"X-BEDS" MARKED BY CALCITE CEMENT.
(PALEOPHYCUS?) STRINGERS SILT/MUD WITH ASSOCIATED BURROWING WEAKLY BURROWED
Pa w/ As
oversteepened
discontinuous shale lamina @ 35°
35°
oversteepened
40-50°
30
30°

1377.7
1373.6

V fine sand
w/ minor silt/mud
?? x beds / HCS ?
rare ripples

L. HFWY

DOIG
coarse cobble conglomerate
(as in d-B96-I)
chaotic

V fine sand
< 1% silt/mud stringers
weak local burrowing

1359.15 on contact @ 30°

x-bedding locally highlighted by calc cement
generally 20-25°
shale laminae oversteepened @ 30-35°
∴ ↓ ∂ x bedding (<10°)

contact: shale laminae @ 40-50°

V fine sand w/ 5-15% silt/mud lamina

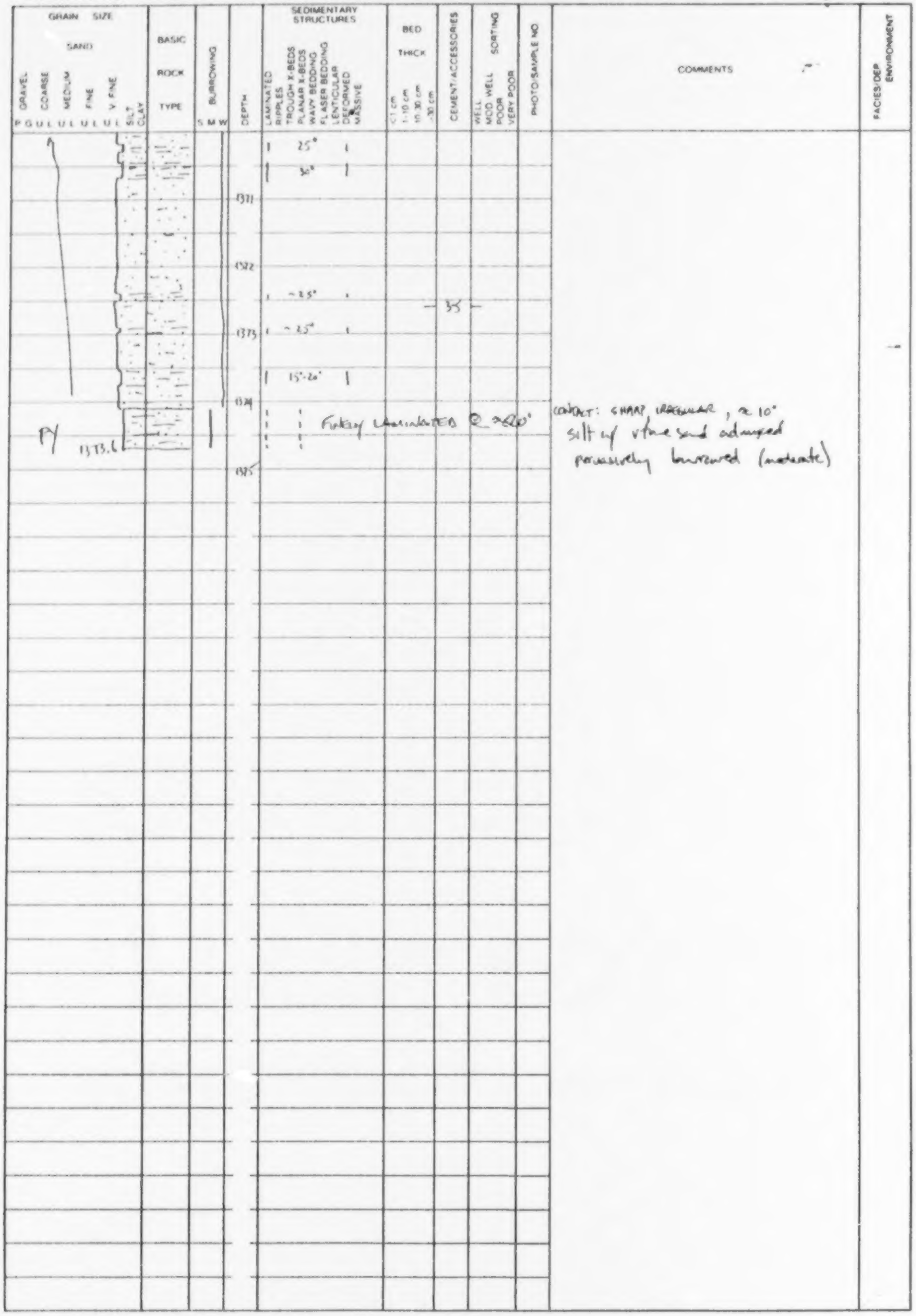
1368.70 - 1368.85 shale fabric?
discontinuous shale laminae (or rip-ups on bedding plane) @ 30°

variably (but weakly) burrowed

p 2 of 2

WELL NAME: Esso Gulf Buck d-35-A FORMATION: Doig (+/- Halfway) DATE: 02/01/94

LOCATION: d-35-A /94-A-14 CORE INTERVAL: 1353.0 - 1379.70 KB: 679.9



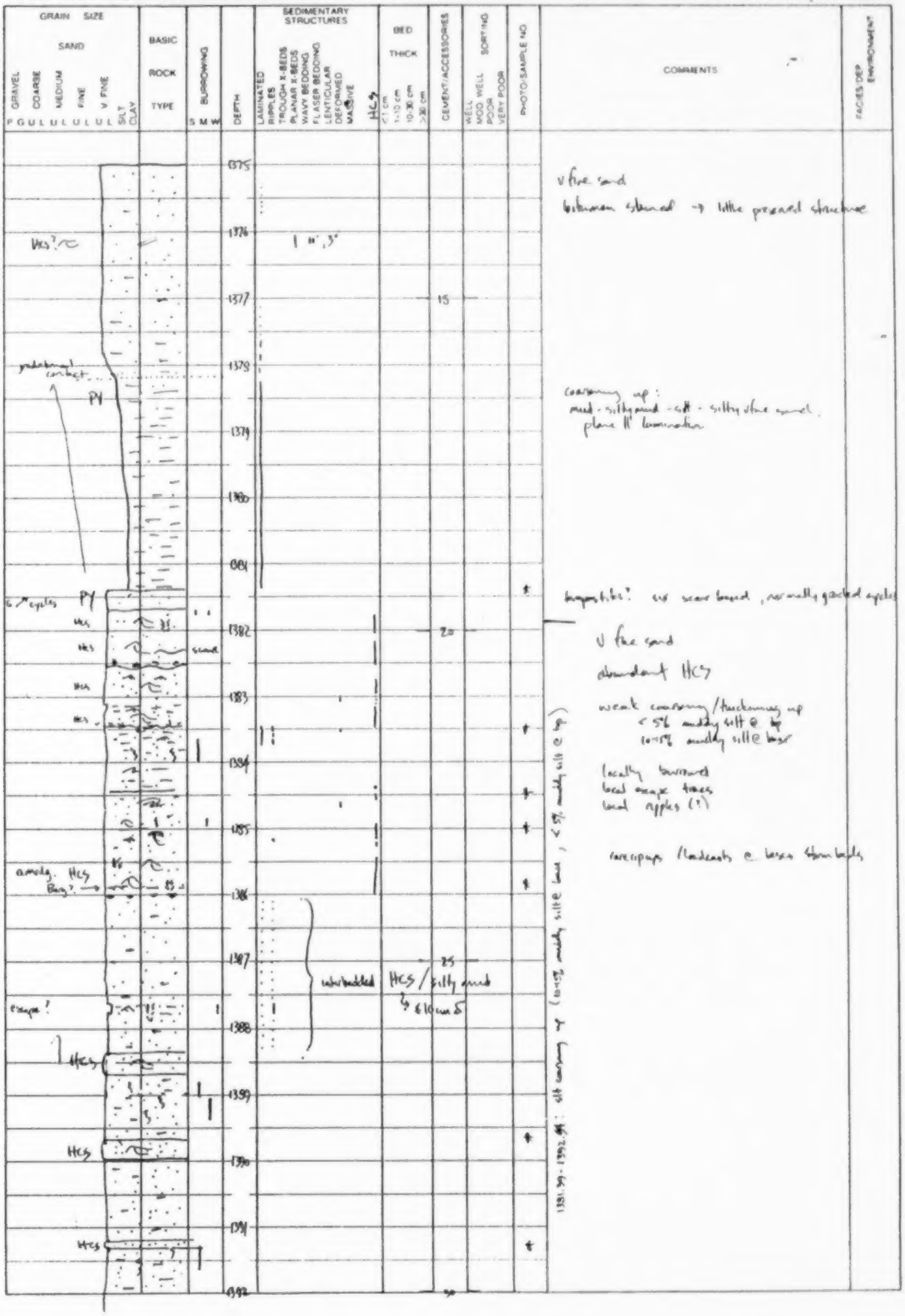
GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
P G U L U L U L U L
SILT
CLAY
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP ENVIRONMENT
25°
30°
1371
1372
~25°
35
1373
~25°
15°-20°
1374
Finely laminated @ ≈20°
PY
1373.6
1375

CONTACT: SHARP, IRREGULAR, ≈ 10°
silt w/ vfine sand admixed
pervasively burrowed (moderate)

p. 1 of 3

WELL NAME: Gulf et al Buick d-58-A FORMATION: HFWY / DOIG DATE 02/02/94

LOCATION: d-58-A / 94-A-14 CORE INTERVAL: 1375.0 - 1411.0 KB 758.4


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
HCS
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD. WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES DEP. ENVIRONMENT
1375
1376
1377
1378
1379
1380
1381
1382
1383
1384
1385
1386
1387
1388
1389
1390
1391
1392
HCS?
gradational contact
PY
6 cycles
HCS
amalg. HCS
Burg?
escape?
15
20
25
30
scour
interbedded HCS / silty mud
≤ 10 cm

v fine sand

bitumen stained → little preserved structure

coarsening up:
mud - silty mud - silt - silty v fine sand,
plane ll lamination

tempestites? scour based, normally graded cycles

v fine sand

abundant HCS

weak coarsening / thickening up
< 5% muddy silt @ top
10-15% muddy silt @ base

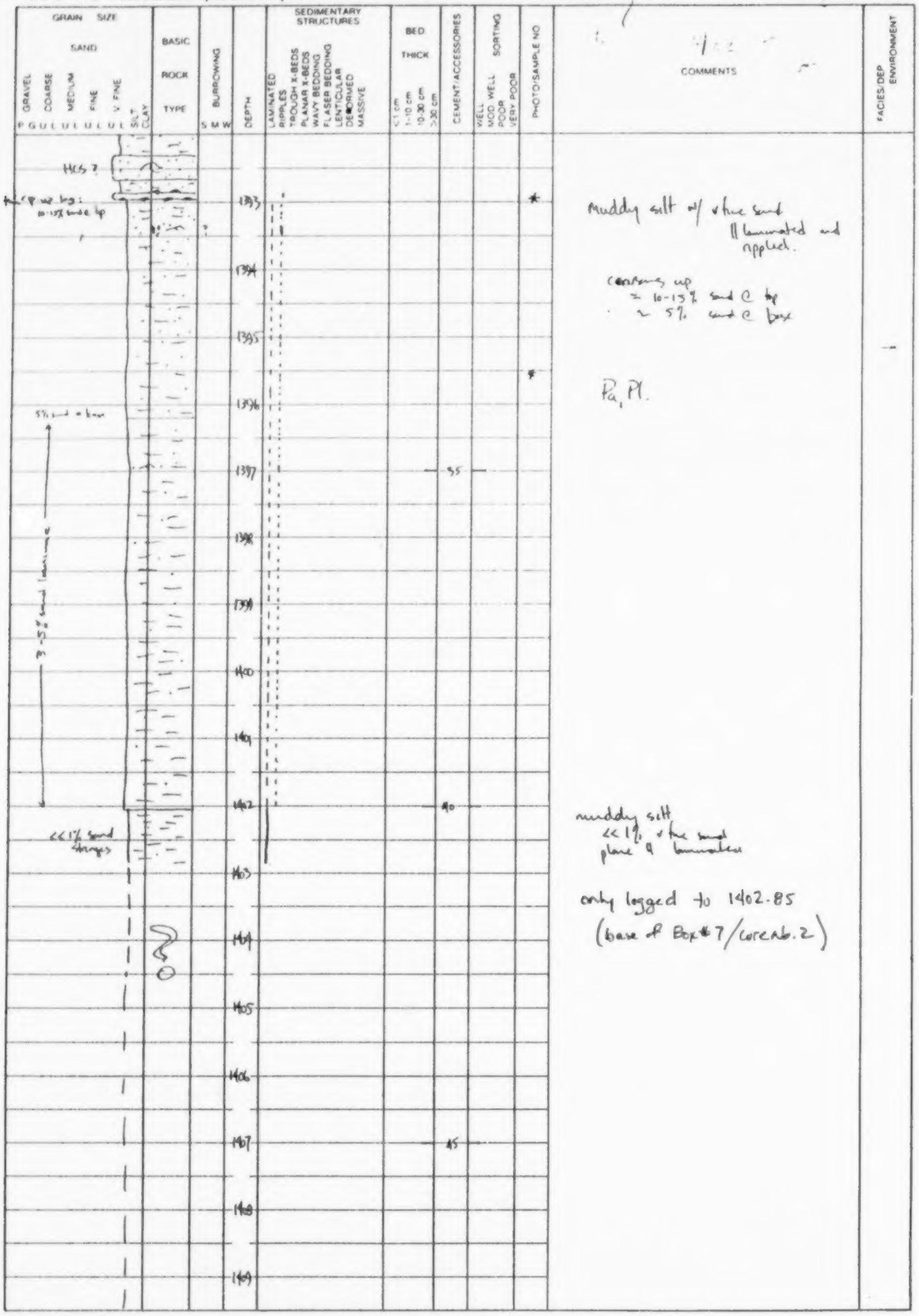
locally burrowed
local escape traces
local ripples (?)

rip-up clasts / mudclasts @ bases storm beds

1381.39 - 1392.94: silt coarsening ↑ (10-15% muddy silt @ base, < 5% muddy silt @ top)

p. 2 of 3

WELL NAME: Gulf et al. Buck d-58-A
FORMATION: HFWY / DOIG
DATE: 02/03/94
LOCATION: d-58-A / 94-A-14
CORE INTERVAL: 1375.0 - 1411.0
KB: 758.4


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
P G U L U L U L U L U L SILT CLAY
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP ENVIRONMENT
HCS?
thin r.p. w/ bg:
10-15% sand top
5% sand @ base
3-5% sand laminae
<<1% sand stringers
1393
1394
1395
1396
1397
1398
1399
1400
1401
1402
1403
1404
1405
1406
1407
1408
1409
35
40
45
*
*

Muddy silt w/ v fine sand
|| laminated and rippled.

coarsens up
≈ 10-15% sand @ top
~ 5% sand @ base

Pa, Pl.

muddy silt
<<1% v fine sand
plane || laminations

only logged to 1402.85
(base of Box #7 / core no. 2)

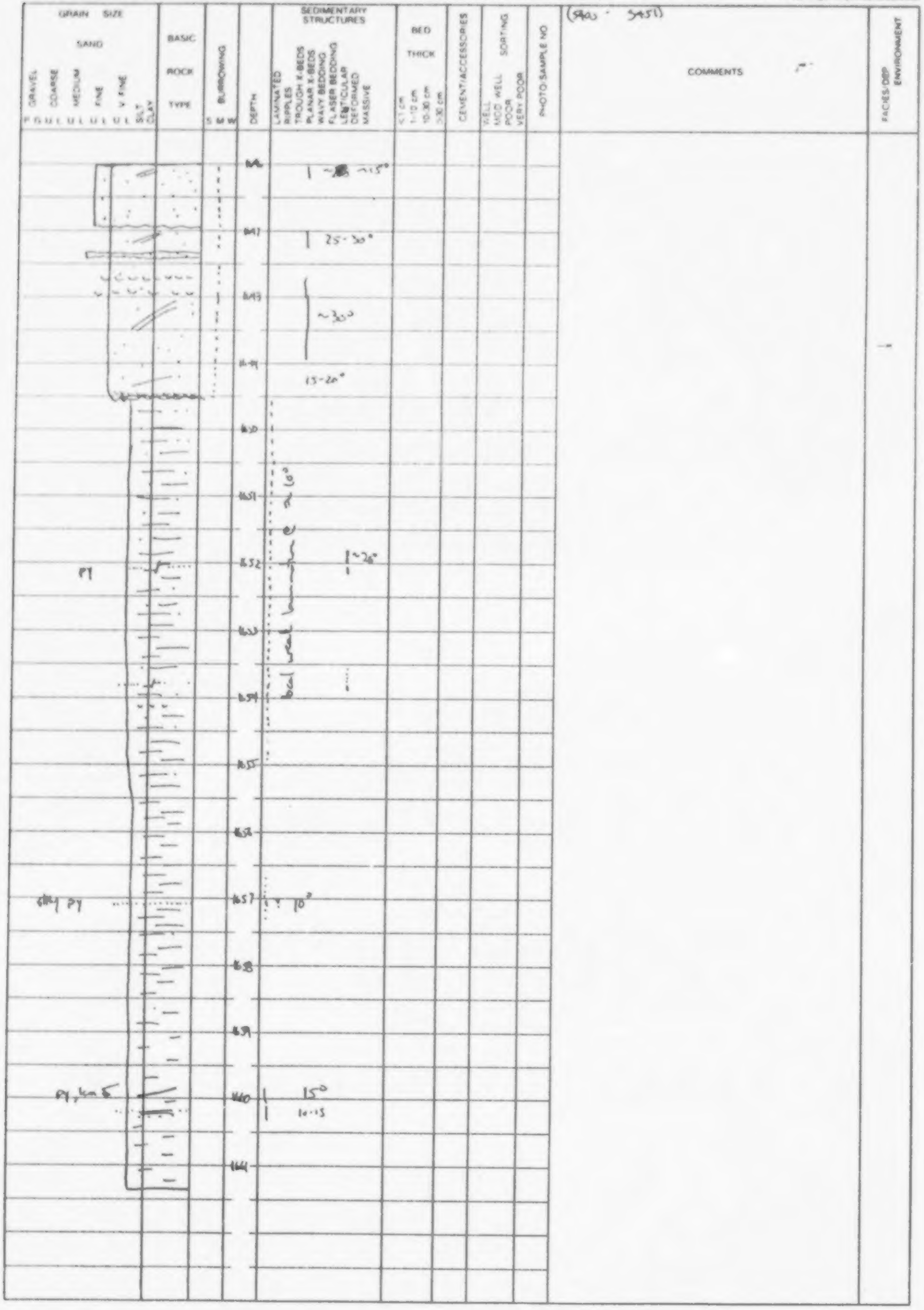
p 245

WELL NAME: Gulf et al Buck d-58-A FORMATION: HFNY/DOIG DATE: 02/03/94

LOCATION: d-58-A / 94-A-14 CORE INTERVAL: 1375.0 - 1411.0 KB: 758.4

| GRAIN SIZE SAND GRAVEL COARSE MEDIUM FINE V FINE SILT CLAY P G U L U L U L U L | BASIC ROCK TYPE | BURROWING S M W | DEPTH | SEDIMENTARY STRUCTURES LAMINATED RIPPLES TROUGH X-BEDS PLANAR X-BEDS WAVY BEDDING FLASER BEDDING LENTICULAR DEFORMED MASSIVE | BED THICK <1 cm 1-10 cm 10-30 cm >30 cm | CEMENT/ACCESSORIES | SORTING WELL MOD WELL POOR VERY POOR | PHOTO/SAMPLE NO | COMMENTS | FACIES/DEP ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1410 | | | | | | | |
| | | | 1411 | | | | | | | |

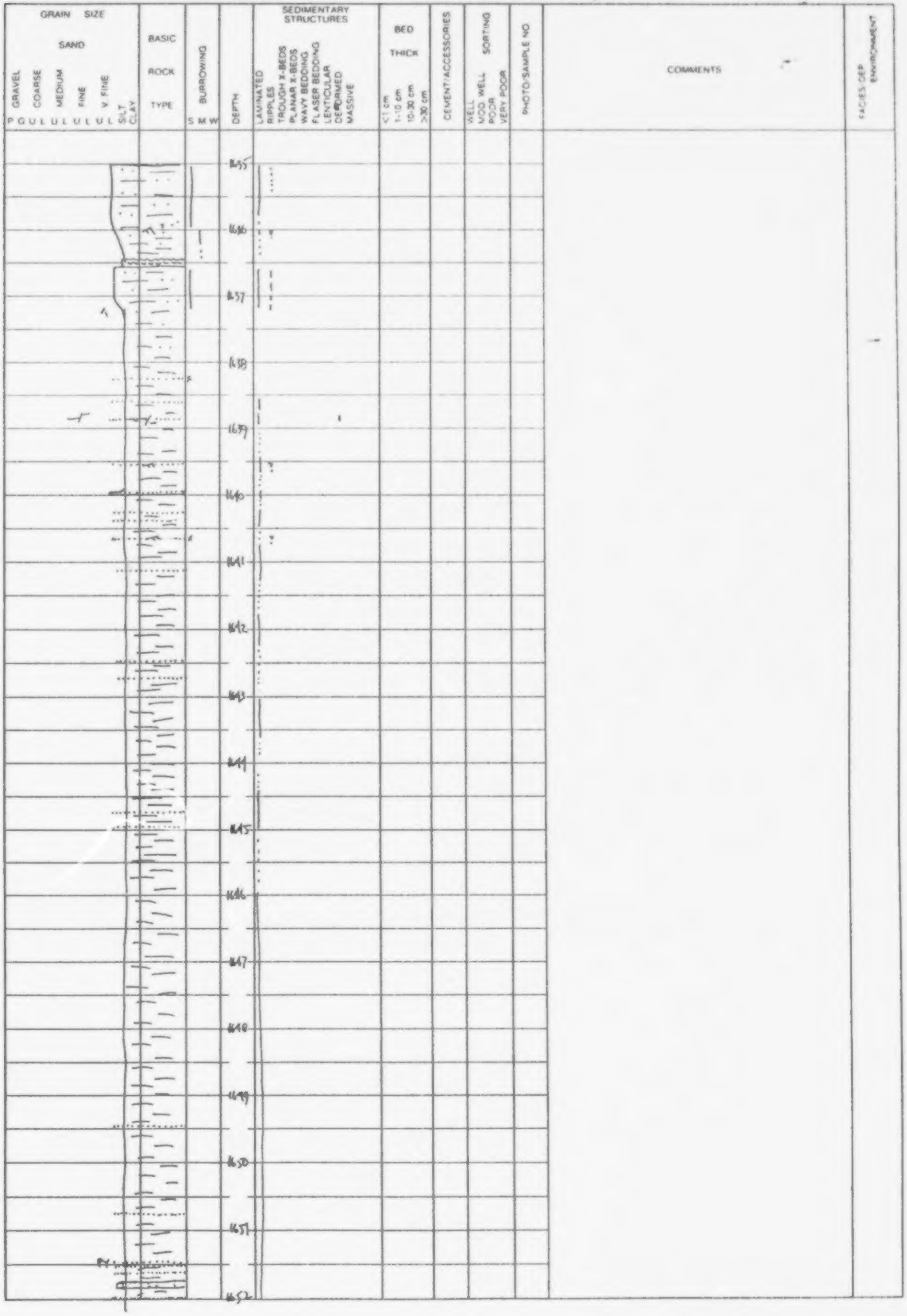
WELL NAME: Petrocanada et al Fireweed
FORMATION: Doig
DATE: June 6th/94
LOCATION: b-6-D/94-A-14
CORE INTERVAL: 1646.0 — 1661.0
KB: 816.9m


(5400 - 5451)
GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO.
COMMENTS
FACIES/DEP ENVIRONMENT
1646
~15°
1647
25-30°
1648
~30°
1649
15-20°
1650
1651
bed well laminate @ ~10°
1652
PY
~20°
1653
1654
1655
1656
1657
silty PY
10°
1658
1659
1660
PY, bur S
15°
10-15
1661

p19.2

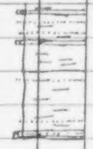
WELL NAME: Fina Fireweed d-15-D FORMATION: Dolly DATE: June 6th / 199[illegible]

LOCATION: d-15-D /94-A-14 CORE INTERVAL: 1635 - ~~1653~~ 1654 KB: 821.8


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP. ENVIRONMENT
1635
1636
1637
1638
1639
1640
1641
1642
1643
1644
1645
1646
1647
1648
1649
1650
1651
1652

WELL NAME: Fina Fireweed d-15-D FORMATION: Doig DATE: June 6th /94

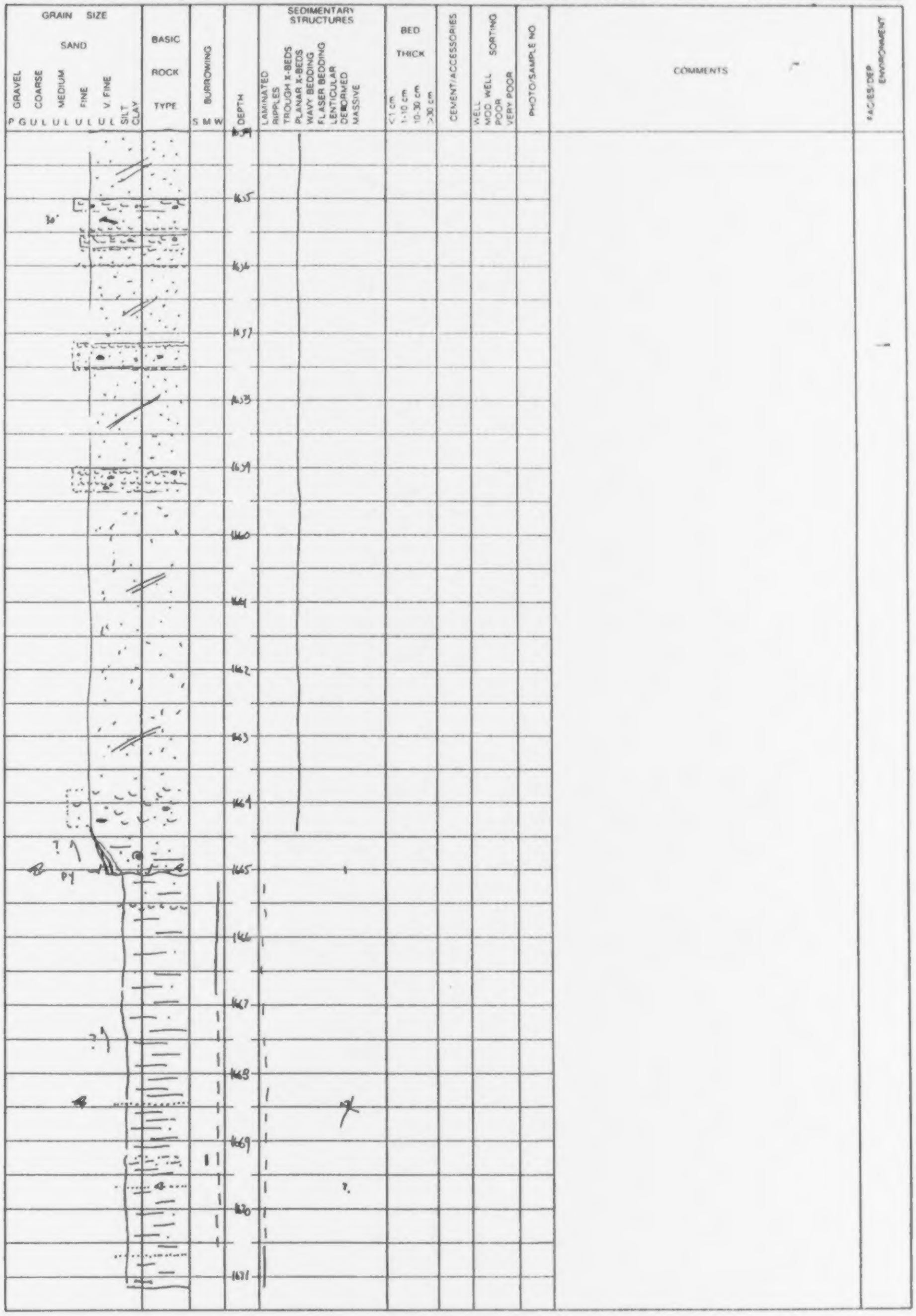
LOCATION: d-15-D /94-A-14 CORE INTERVAL: 1635 - ~~1655~~ 1654 KB:



| GRAIN SIZE<br>GRAVEL · SAND (COARSE, MEDIUM, FINE, V. FINE) · SILT · CLAY<br>P G U L U L U L U L S C | BASIC ROCK TYPE | BURROWING<br>S M W | DEPTH | SEDIMENTARY STRUCTURES<br>LAMINATED<br>RIPPLES<br>TROUGH X-BEDS<br>PLANAR X-BEDS<br>WAVY BEDDING<br>FLASER BEDDING<br>LENTICULAR<br>DEFORMED<br>MASSIVE | BED THICK<br><1 cm<br>1-10 cm<br>10-30 cm<br>>30 cm | CEMENT/ACCESSORIES | SORTING<br>WELL<br>MOD. WELL<br>POOR<br>VERY POOR | PHOTO/SAMPLE NO. | COMMENTS | FACIES/DEP. ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1652 | | | | | | | |
| | | | 1653 | | | | | | | |
| | | | 1654 | | | | | | | |

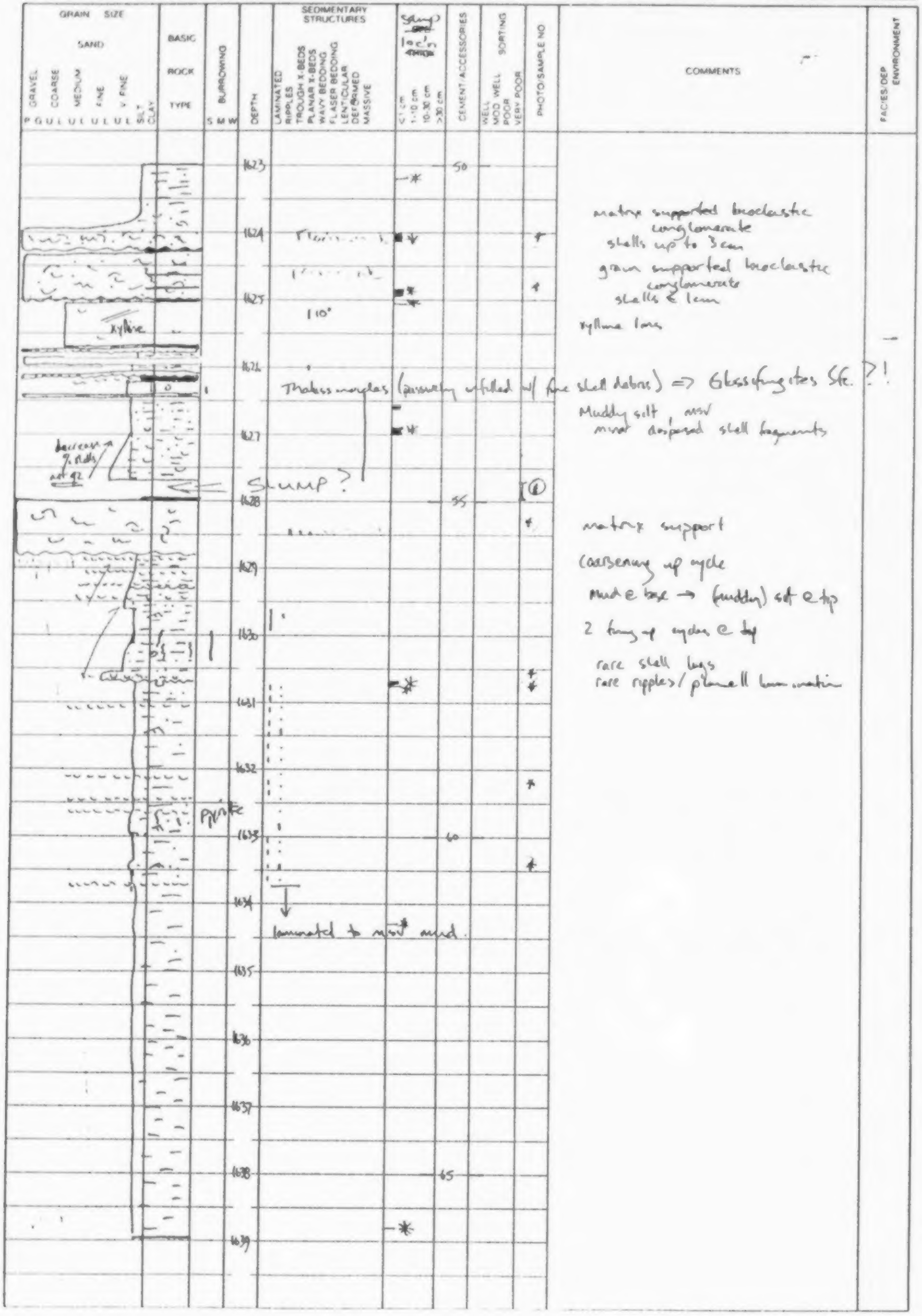
WELL NAME: Czar Orbit Fina Fireweed b-26-D FORMATION: Doig DATE: June 6th/7th, 9?

LOCATION: b-26-D / 94-A-14 CORE INTERVAL: 1654 m - 1671.13 m 5425' - 5482' KB: 2735'


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD. WELL
POOR
VERY POOR
PHOTO/SAMPLE NO.
COMMENTS
FACIES/DEP. ENVIRONMENT
1654
1655
1656
1657
1658
1659
1660
1661
1662
1663
1664
1665
1666
1667
1668
1669
1670
1671
30°
?
py
?

WELL NAME: Cdn Sup Fireweed d-37-D FORMATION: Doig DATE: 02/04/94

LOCATION: d-37-D/94-A-14 CORE INTERVAL: 1623 - 1638.99 KB: 801 m


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
Slump? loc'n
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP ENVIRONMENT
1623
1624
1625
1626
1627
1628
1629
1630
1631
1632
1633
1634
1635
1636
1637
1638
1639
50
55
60
65
xyline
110°
decrease % fills
SLUMP?
Pyrite
①

matrix supported bioclastic conglomerate
shells up to 3 cm

grain supported bioclastic conglomerate
shells ≤ 1 cm

xyline lens

Thalassinoides (possibly infilled w/ fine shell debris) ⇒ Glossifungites Sfc. ?!

Muddy silt, msv
minor dispersed shell fragments

matrix support

coarsening up cycle
mud @ base → (muddy) silt @ top
2 fining up cycles @ top
rare shell lags
rare ripples/planar lamination

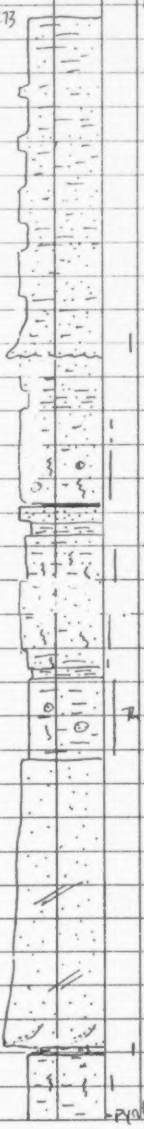
laminated to msv mud.

p.1 of 2

WELL NAME: Total Canco Buck b-58-D FORMATION: CHLK - HFWY ½- DBG DATE: 02/03/94

LOCATION: b-58-D / 94-A-15 CORE INTERVAL: 1275.2 - 1293.~~2~~ -.4 (1273 - 1291.2) KB: -

| GRAIN SIZE: GRAVEL, SAND (COARSE, MEDIUM, FINE, V FINE), SILT, CLAY — P G U L U L U L U L | BASIC ROCK TYPE | BURROWING S M W | DEPTH | SEDIMENTARY STRUCTURES: LAMINATED, RIPPLES, TROUGH X-BEDS, PLANAR X-BEDS, WAVY BEDDING, FLASER BEDDING, LENTICULAR, DEFORMED, MASSIVE | Samp. loc'n. ~~THICK~~ <1 cm, 1-10 cm, 10-30 cm, >30 cm | CEMENT/ACCESSORIES | SORTING: WELL, MOD. WELL, POOR, VERY POOR | PHOTO/SAMPLE NO | COMMENTS — QUICK LOG. | FACIES/DEP. ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|



1273

Terebellina

Pa, Oph?

Pa, Pc?

1285-

Depth: 1275, 1276, 1277, 1278, 1279, 1280, 1281, 1282, 1283, 1284, 1285, 1286, 1287, 1288, 1289, 1290, 1291

(1274) -

Pc?, Pa

- 1284

0

25-30°

25-30°

1290.2

tied to Gamma log

2. 5

pyrite

v fine sandy silt w/ v fine sand interbeds

silts pale olive grn, anhydrite?
sands mottled
=> Te? Oph? Th?
=> Pa

CHLK?

Sand fine, x-bedded
fining up:
upper v fine @ top
fine + upper fine @ base

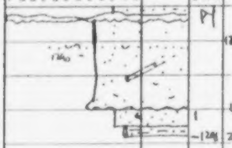
+ X x-beds @ 25-30°
planar tabular and trough.

v fine sandy silt to silty v fine sand
variably burrowed to locally mottled
weak horizontal lamination

p 4 c

WELL NAME: ______ FORMATION: ______ DATE: 02/03/94

LOCATION: b-86-D / 94-A-15 CORE INTERVAL: CORE No. 2 ~~1275.2~~ 1293.~~2~~ .4 KB: -

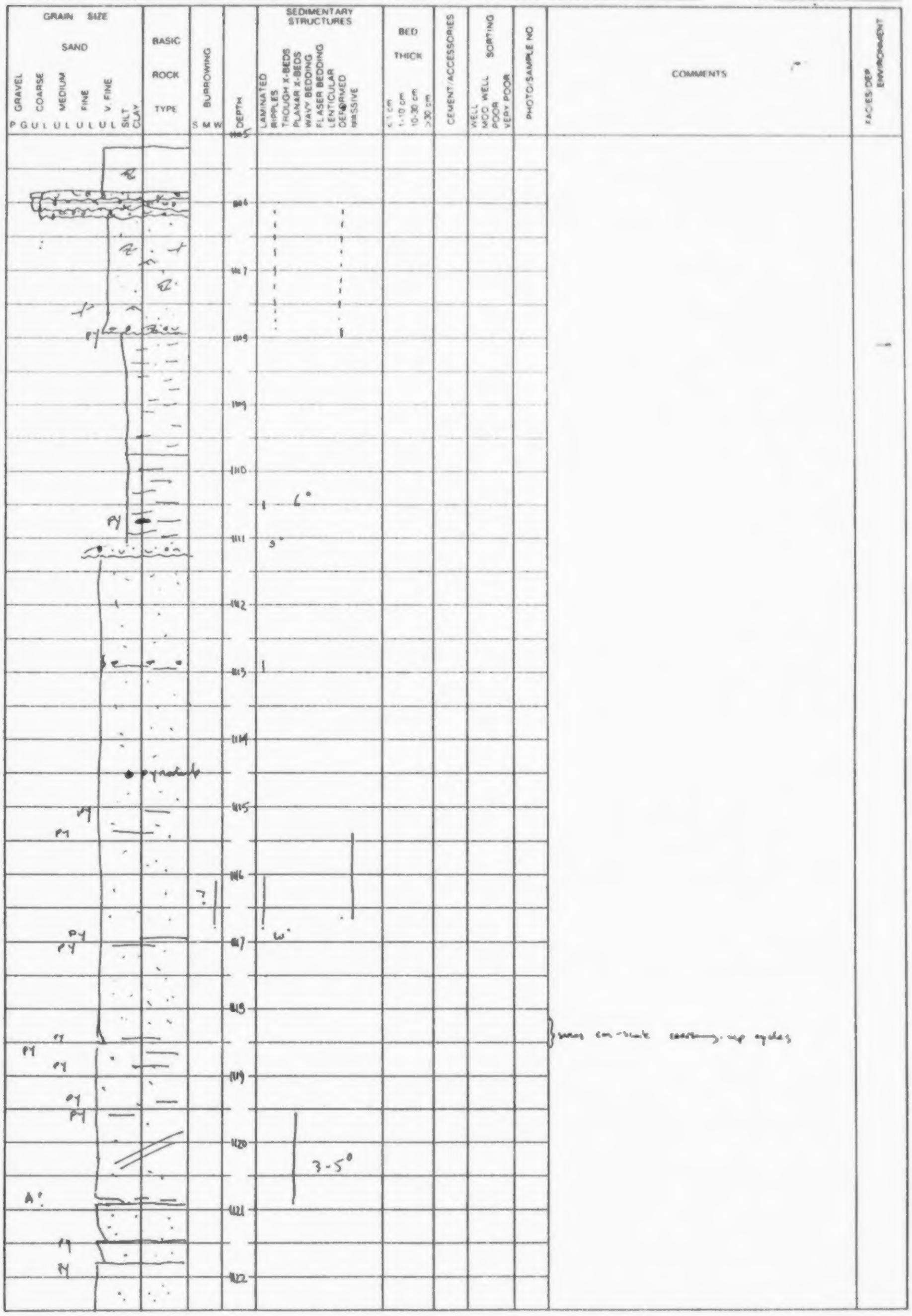


| GRAIN SIZE<br>GRAVEL, SAND (COARSE, MEDIUM, FINE, V FINE), SILT, CLAY<br>P G U L U L U L U L | BASIC ROCK TYPE | BURROWING<br>S M W | DEPTH | SEDIMENTARY STRUCTURES<br>LAMINATED, RIPPLES, TROUGH X-BEDS, PLANAR X-BEDS, WAVY BEDDING, FLASER BEDDING, LENTICULAR, DEFORMED, MASSIVE | samp. ~~BED~~ luc'n. ~~THICK~~<br><1 cm, 1-10 cm, 10-30 cm, >30 cm | CEMENT/ACCESSORIES | SORTING<br>WELL, MOD WELL, POOR, VERY POOR | PHOTO/SAMPLE NO | COMMENTS | FACIES/DEP ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | P\| | | 1 Chaotic | | | | ‡ | ★NOTE: Photos labelled 1292.61, 1292.69 | |
| | | | 1292 | \|25° | | | | | upper v fine to fine sand. | |
| | | | 1293 | | —* | | | + | | |
| | | 1 | | | | Gyp— | - | + | muddy silt | |
| | | | -1293.2 | 1 1 | | | | | horizontal to silty wavy | |

p1.42

WELL NAME: Pacific Sr Candel Williams  FORMATION: DOIG  DATE: June 7th/94

LOCATION: d-84-I / 94-A-15  CORE INTERVAL: 1105.2m - 1129.7m (measured) 3425' to 3714  KB: 2334'


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP ENVIRONMENT
1105
1106
1107
1108
1109
1110
1111
1112
1113
1114
1115
1116
1117
1118
1119
1120
1121
1122
py
py
pyrite nodule
py
py
py
py
py
py
py
py
py
A!
py
py
?
6°
5°
6°
3-5°

} some cm-scale coarsening-up cycles

WELL NAME:

FORMATION:

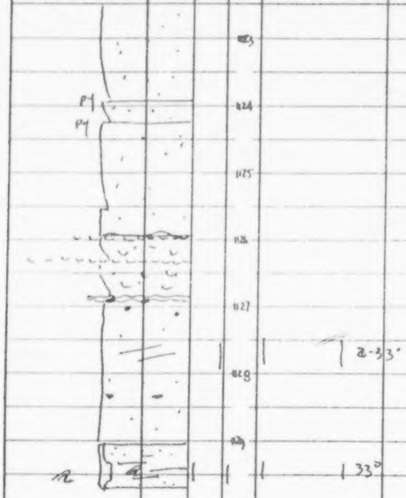
DATE: June 7th /94

LOCATION: d-84-I /94-A-15

CORE INTERVAL:

KB: 2334

| GRAIN SIZE<br>SAND<br>GRAVEL P G · COARSE U L · MEDIUM U L · FINE U L · V FINE U L · SILT · CLAY | BASIC ROCK TYPE | BURROWING S M W | DEPTH | SEDIMENTARY STRUCTURES<br>LAMINATED<br>RIPPLES<br>TROUGH X-BEDS<br>PLANAR X-BEDS<br>WAVY BEDDING<br>FLASER BEDDING<br>LENTICULAR<br>DEFORMED<br>MASSIVE | BED THICK<br><1 cm<br>1-10 cm<br>10-30 cm<br>>30 cm | CEMENT/ACCESSORIES | SORTING<br>WELL<br>MOD WELL<br>POOR<br>VERY POOR | PHOTO/SAMPLE NO | COMMENTS | FACIES/DEP ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|



p. 1 of 2

WELL NAME: ____

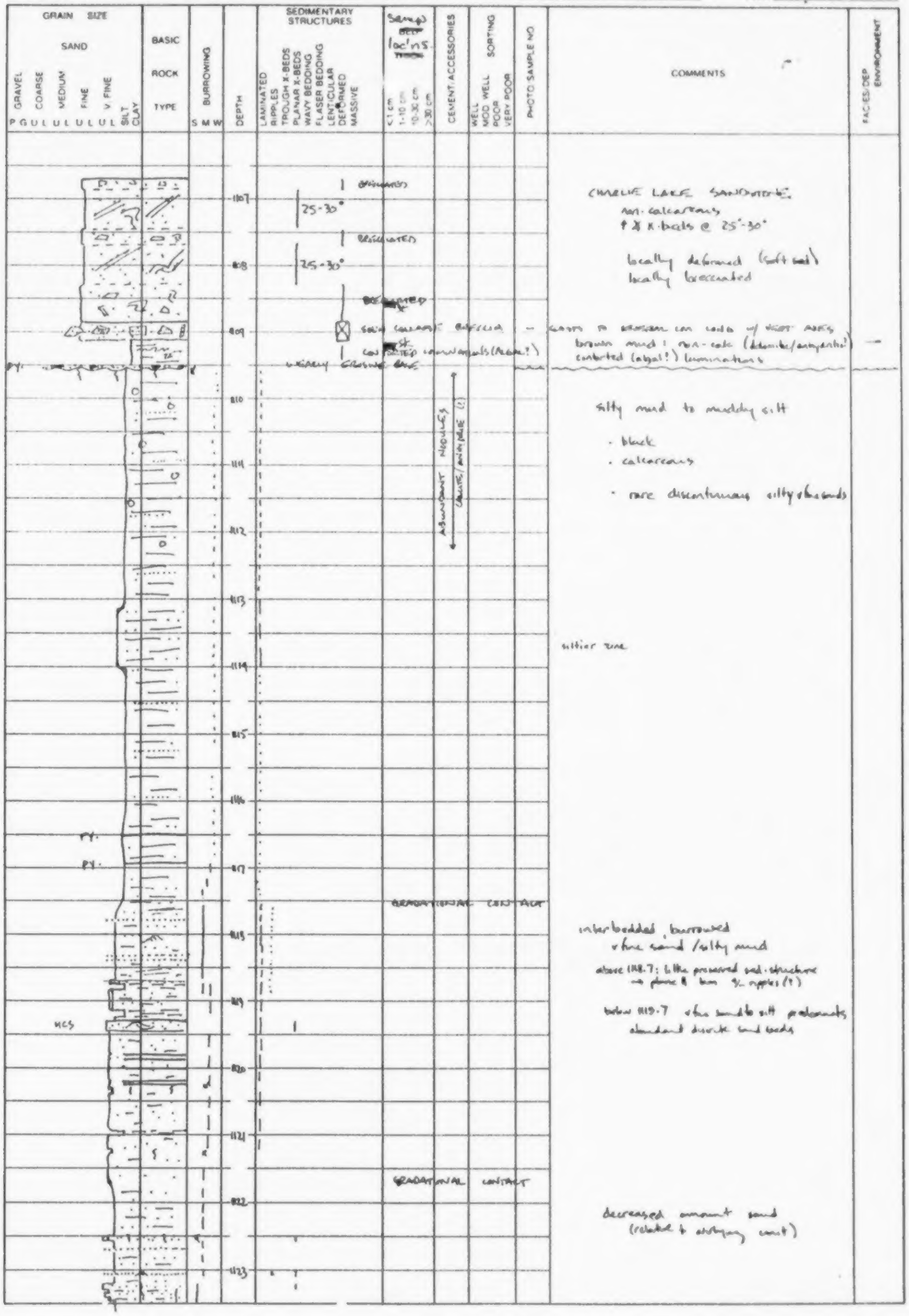
FORMATION: CHARLIE LAKE – DOIG

DATE: June 9th, 1994

LOCATION: b-10-c /94-H-1

CORE INTERVAL: 806.7m – 825.65m

KB: ____


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
Samp's ~~BED~~ loc'ns. ~~THICK~~
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO SAMPLE NO
COMMENTS
FACIES/DEP ENVIRONMENT
807
808
809
810
811
812
813
814
815
816
817
818
819
820
821
822
823
BRECCIATED
25-30°
BRECCIATED
25-30°
BRECCIATED
SOLN COLLAPSE BRECCIA
CONTORTED laminations (algae?)
WEAKLY EROSIVE BASE
PY.
ABUNDANT NODULES
CALCITE/ANHYDRITE (?)
PY.
PY.
GRADATIONAL CONTACT
HCS
GRADATIONAL CONTACT

CHARLIE LAKE SANDSTONE:
non-calcareous
P & X-beds @ 25°-30°

locally deformed (soft sed)
locally brecciated

– clasts of [illegible] in matrix of [illegible] – brown mud: non-calc (dolomite/anhydrite?) contorted (algal?) laminations

silty mud to muddy silt
- black
- calcareous
- rare discontinuous silty vf sands

siltier zone

interbedded burrowed
vfine sand / silty mud

above 818.7: little preserved sed. structure → planar & low ∠ ripples (?)

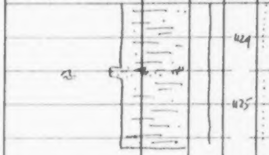
below 819.7 vfine sand to silt predominates
abundant discrete sand beds

decreased amount sand
(related to overlying unit)

p. 2 of 2

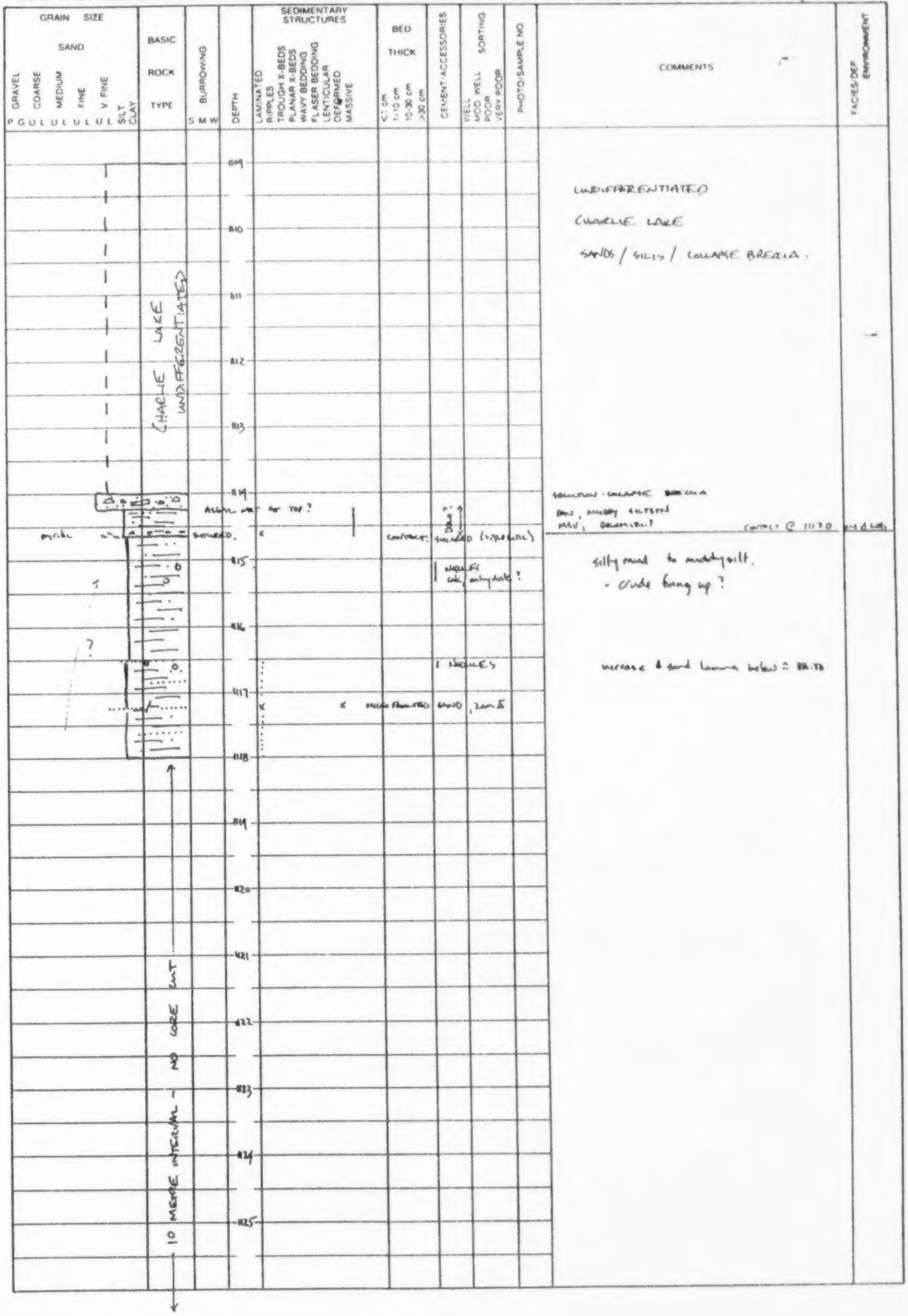
WELL NAME: FORMATION: DATE:

LOCATION: b-10-C /94-H-1 CORE INTERVAL: KB:

| GRAIN SIZE<br>GRAVEL P G · SAND: COARSE U L · MEDIUM U L · FINE U L · V. FINE U L · SILT · CLAY | BASIC ROCK TYPE | BURROWING S M W | DEPTH | SEDIMENTARY STRUCTURES<br>LAMINATED<br>RIPPLES<br>TROUGH X-BEDS<br>PLANAR X-BEDS<br>WAVY BEDDING<br>FLASER BEDDING<br>LENTICULAR<br>DEFORMED<br>MASSIVE | BED THICK<br><1 cm<br>1-10 cm<br>10-30 cm<br>>30 cm | CEMENT/ACCESSORIES | SORTING<br>WELL<br>MOD. WELL<br>POOR<br>VERY POOR | PHOTO/SAMPLE NO | COMMENTS | FACIES/DEP ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|
|  | | | 1124<br>1125 | 1 scour? | | | | | predominantly silty-muddy below 1123.45 | |

p 1 A 2

WELL NAME: HB et al Snowberry d-13-D
FORMATION: CHARLIE LAKE →
DATE: June 9, 1994
LOCATION: d-13-D / 94-H-1
CORE INTERVAL: CORE No. 1: 1109 - 1118
KB: 737.8


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD. WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP. ENVIRONMENT
1109
1110
1111
1112
1113
1114
1115
1116
1117
1118
1119
1120
1121
1122
1123
1124
1125
CHARLIE LAKE UNDIFFERENTIATED
ALGAL MAT AT TOP?
pyrite
SCOURED.
CONTACT: SCOURED (irregular)
NODULES
calc/anhydrite?
NODULES
MICRO FAULTED SAND, 2cm
?
10 METRE INTERVAL - NO CORE CUT

UNDIFFERENTIATED
CHARLIE LAKE
SANDS / SILTS / COLLAPSE BRECCIA.

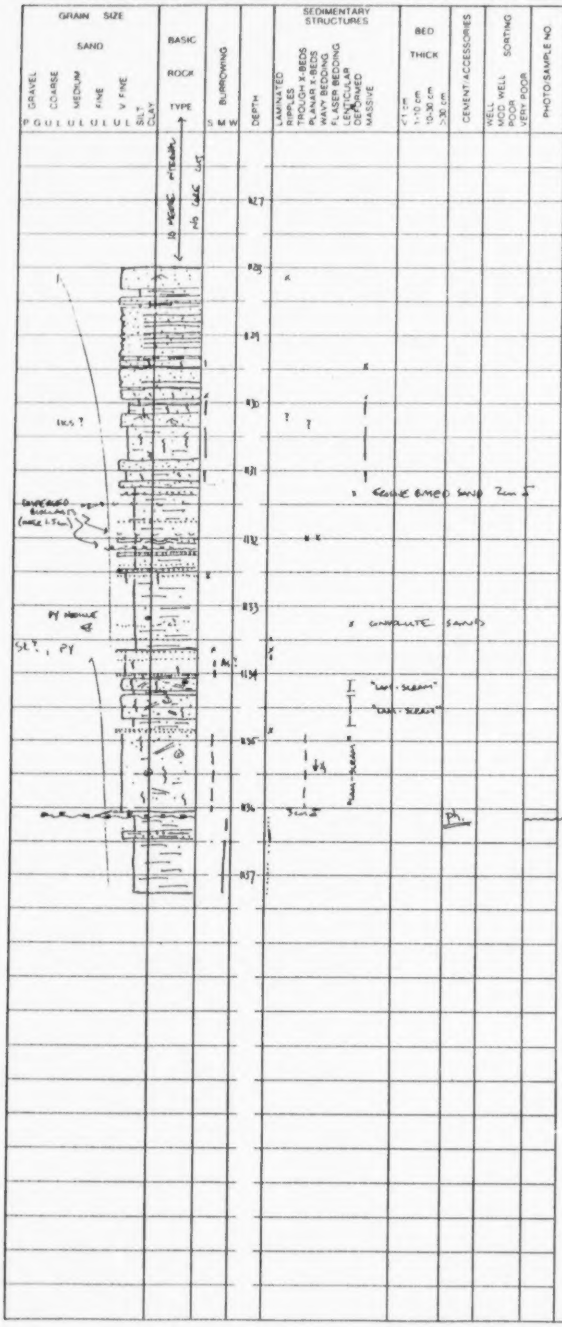
SOLUTION - COLLAPSE BRECCIA
BRN, MUDDY SILTSTONE
MSV, DOLOMITIC?
CONTACT @ 1114.0

silty sand to muddy silt.
- crude fining up?

increase of sand lamina below ≈ 1116.70

p. 2 of 2

WELL NAME:
FORMATION: Dox
DATE:
LOCATION: d-13-D / 94-H-1
CORE INTERVAL: CORE No. 2: 1128 - 1137.28
KB:


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO.
10 metre interval no core cut
1127
1128
1129
1130
1131
1132
1133
1134
1135
1136
1137
HCS ?
elongated bioclasts (max 1.5cm)
PY nodule
SC?, PY
coarse grained sand 2cm
convolute sand
"LAM-SCREAM"
"LAM-SCREAM"
3cm
Ph.

COMMENTS

Coarsening up cycle:
interbedded mud/v fine sand
→ homogenized unit
→ v fine sand.

above 1129.95 : v fine sand beds predominate
1129.5 - 1131.18 : homogenized unit predominant
below 1131.18 : mud-sand couplets predominant

2nd cycle (?)
- less pronounced
- finer overall

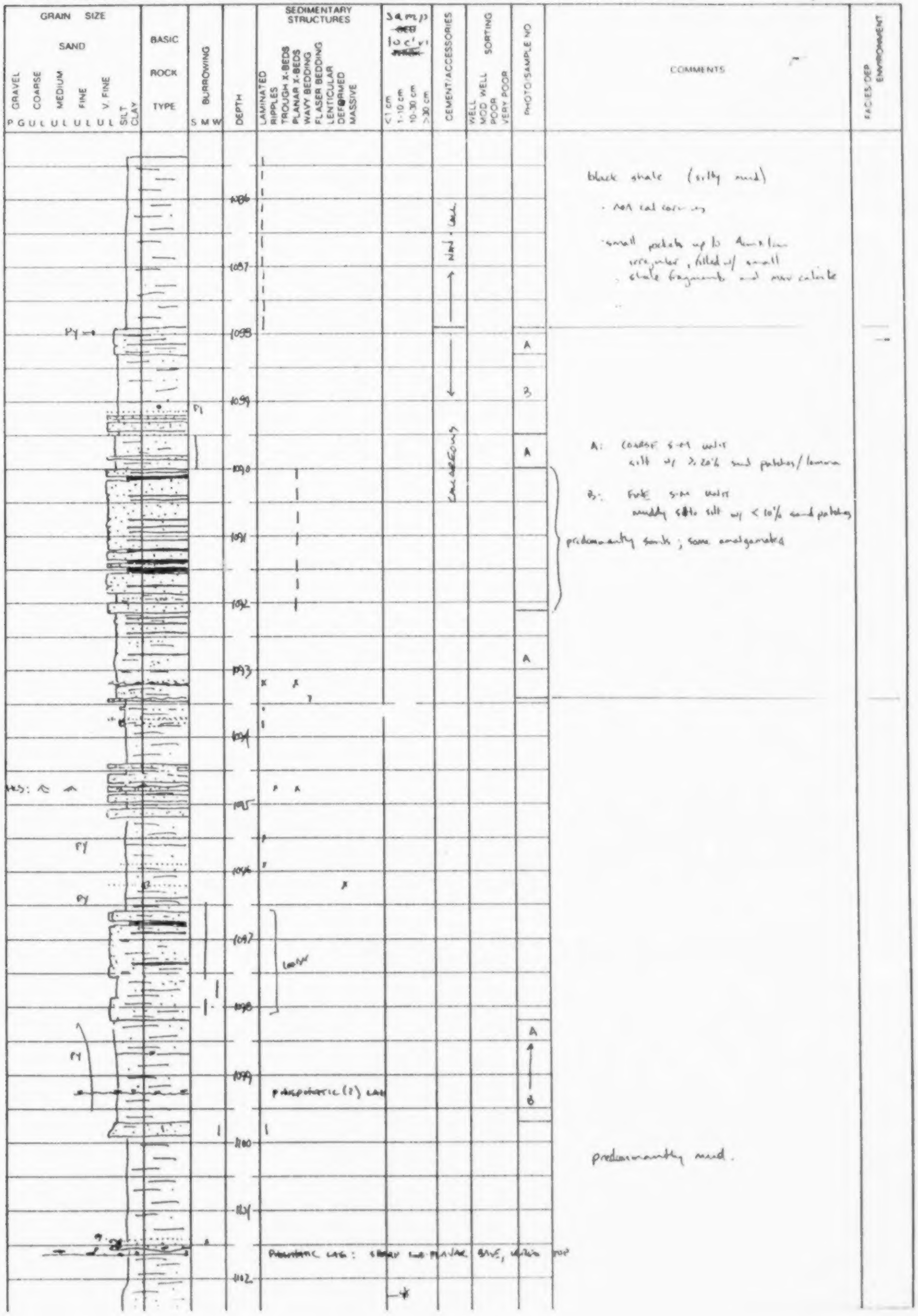
LAG: erosive base, normal grading, sharp irregular top
mud rip ups (coarse sand size)
phosphatic clasts to 7mm
@ base

silty mud - muddy silt
weakly burrowed to laminated

FACIES/DEP ENVIRONMENT

p. 1 of 2

WELL NAME: ASHLAND CK. #3 SAWBERRY
FORMATION: Doig
DATE: June 8th/9th, 1994
LOCATION: b-57 D/94-H-1
CORE INTERVAL: 3560' to 3621'3"
KB: 2345'


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
samp ~~bed~~ loc'n ~~thick~~
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP ENVIRONMENT
1086
1087
1088
1089
1090
1091
1092
1093
1094
1095
1096
1097
1098
1099
1100
1101
1102
Py
Py
HCS
Py
Py
Py
Non - cal
Calcareous
lamin
A
B
A
A
A
B

black shale (silty mud)
- non calcareous
- small pockets up to 4mm x 1cm irregular, filled w/ small shale fragments and minor calcite

A: coarse s-m units
silt w/ ≥ 20% sand patches/lamina

B: fine s-m units
muddy silt to silt w/ < 10% sand patches

predominantly sands; some amalgamated

phosphatic (?) lag

predominantly mud.

Phosphatic lag: sharp and planar base, wavy top

p. 242

WELL NAME ____________________ FORMATION Dm DATE June 9th, 1994

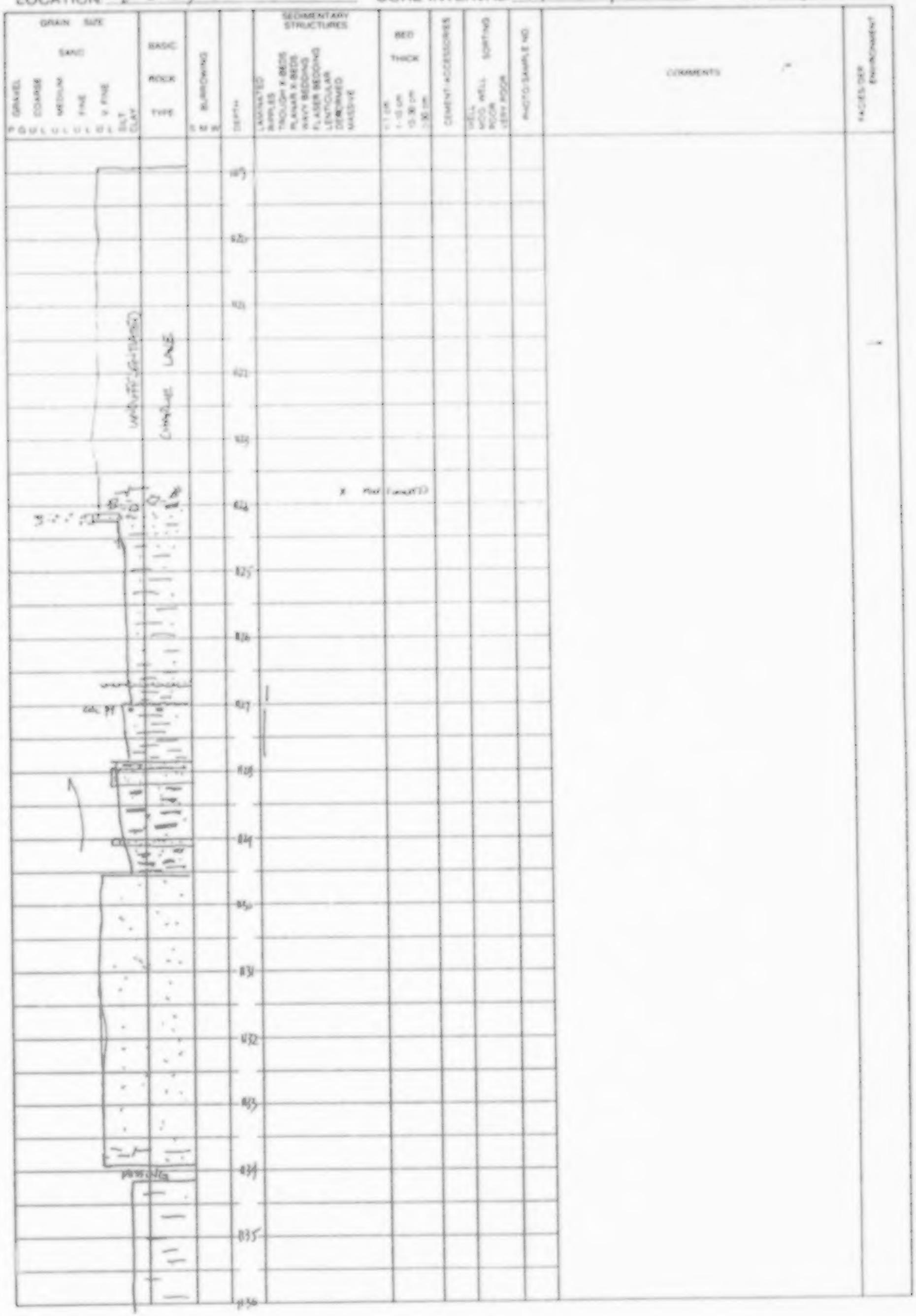
LOCATION b-57-D / 94-H-1 CORE INTERVAL 3596' – 3622' 3" KB ______

| GRAIN SIZE<br>SAND<br>GRAVEL, COARSE, MEDIUM, FINE, V. FINE, SILT, CLAY | BASIC ROCK TYPE | BURROWING<br>S M W | DEPTH | SEDIMENTARY STRUCTURES<br>LAMINATED, RIPPLES, TROUGH X-BEDS, PLANAR X-BEDS, WAVY BEDDING, FLASER BEDDING, LENTICULAR, DEFORMED, MASSIVE | Samp. Facies | CEMENT ACCESSORIES | SORTING<br>WELL, MOD WELL, POOR, VERY POOR | PHOTO/SAMPLE NO. | COMMENTS | FACIES DEP. ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  |  |  |  |  |

p. 142

WELL NAME: Union HB Willowlake d-15-A FORMATION: Dcig DATE: June 8th /84

LOCATION: d-15-A / 94-H-2 CORE INTERVAL: 1140m - 1149m 3470 - 3779 KB: 2345'


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT ACCESSORIES
SORTING
V.WELL
MOD. WELL
POOR
VERY POOR
PHOTO/SAMPLE NO.
COMMENTS
FACIES DEP. ENVIRONMENT
819
820
821
822
823
824
825
826
827
828
829
830
831
832
833
834
835
836
x Plnt frags(?)
cal. pt

p-242

WELL NAME

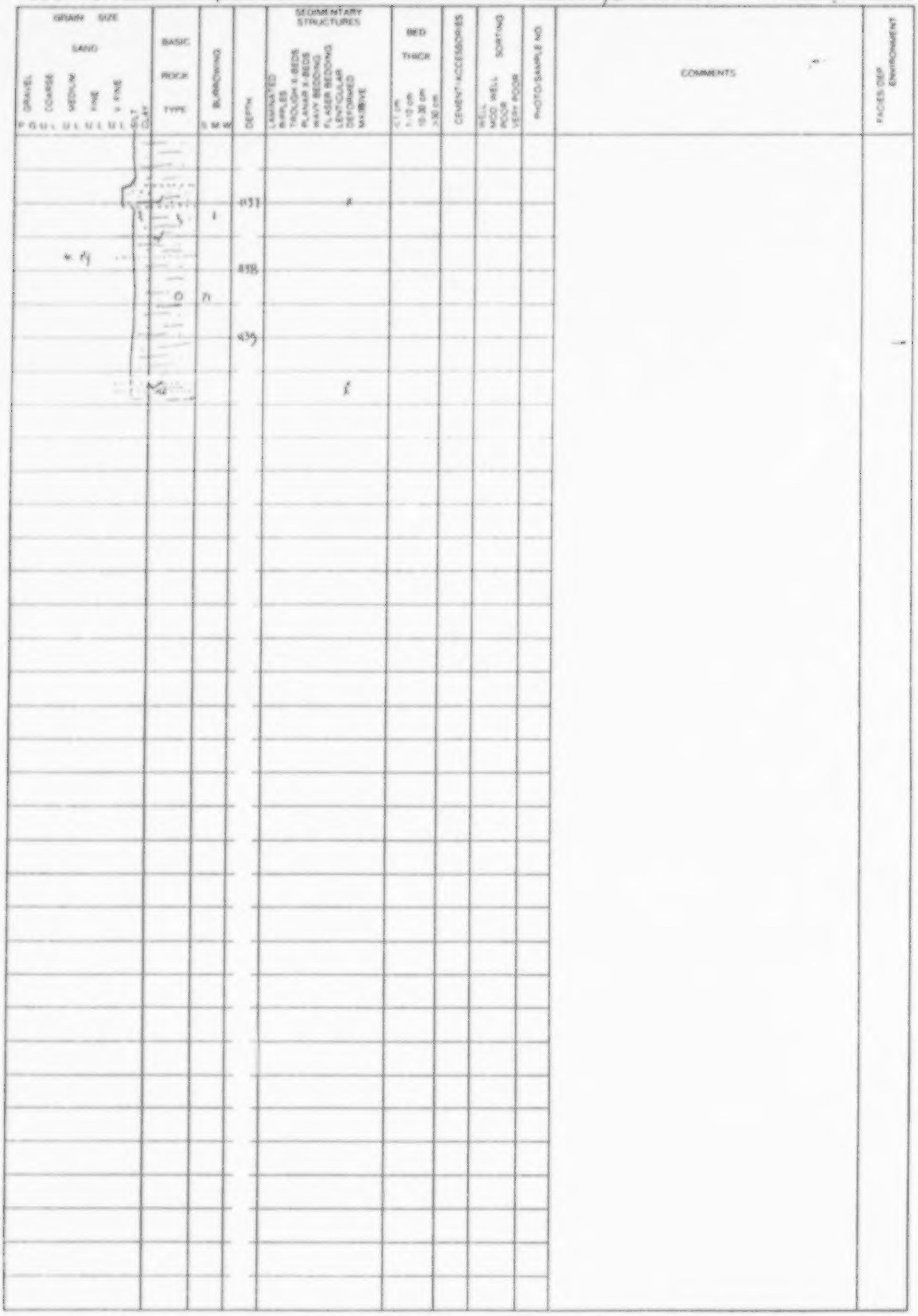
FORMATION: Doig

DATE: Jne 8th /94

LOCATION: d-15-A /94-H-2

CORE INTERVAL: [illegible]

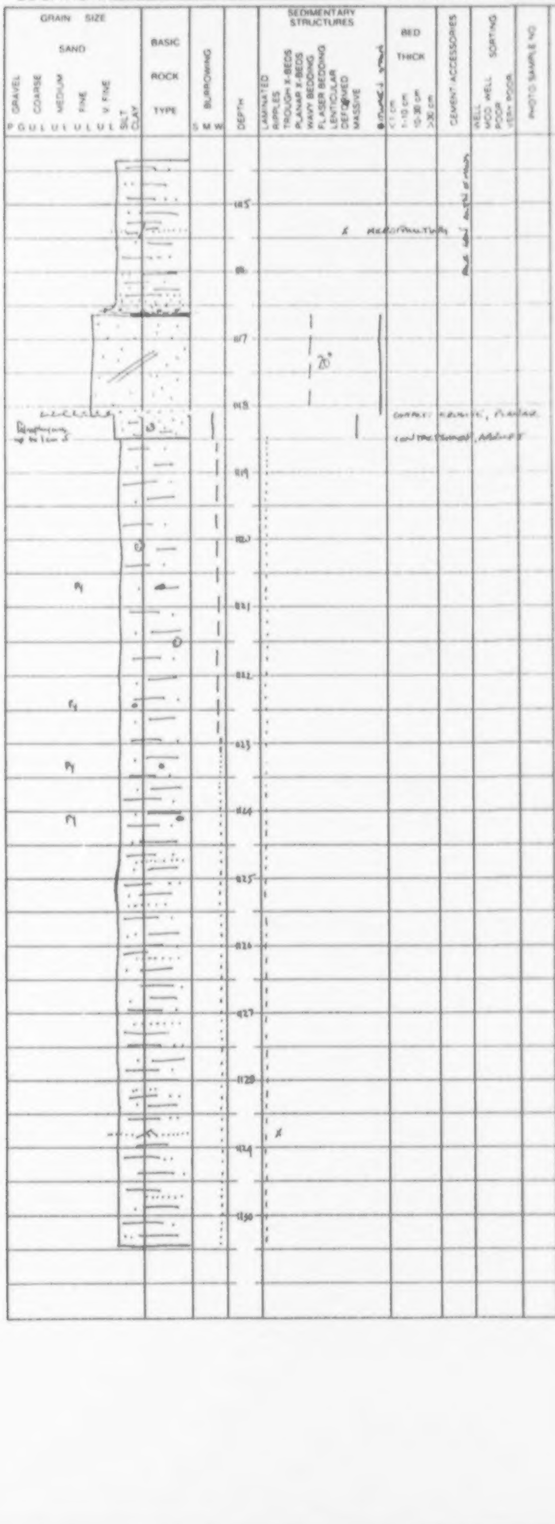
KB:


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD. WELL
POOR
VERY POOR
PHOTO/SAMPLE NO.
COMMENTS
FACIES DEP. ENVIRONMENT
437
438
439
1
O
n
r. Py

[illegible]

WELL NAME: Union HB Wildmint b-24-A FORMATION: Doig DATE June 14, 1999

LOCATION: b-24-A / 94-H-2 CORE INTERVAL: [illegible] 814.35m – 830.45m KB [illegible]



GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
bitumen stained
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO SAMPLE NO
815
816
817
818
819
820
821
822
823
824
825
826
827
828
829
830
x microfractures
20°
contact: erosive, planar
contemporaneous, abrupt
rip-up clasts up to 1cm δ
Pl
Pl
Pl
Pl
x

COMMENTS

irregularly interbedded silts w/
v-fine sand & mud

pale grn alt'n in assoc. w/ mudst

Fine sand (lower-fine)
· bitumen saturated
· faint preserved x-beds @ 20°?

silty v-fine sand to sandy silt
· gen'ly mass / structureless

predominantly silt
w/ v.fine sand laminae (esp. below 819.?)

calcareous

burrowed:
minor, large (5mm+) horizontal elements

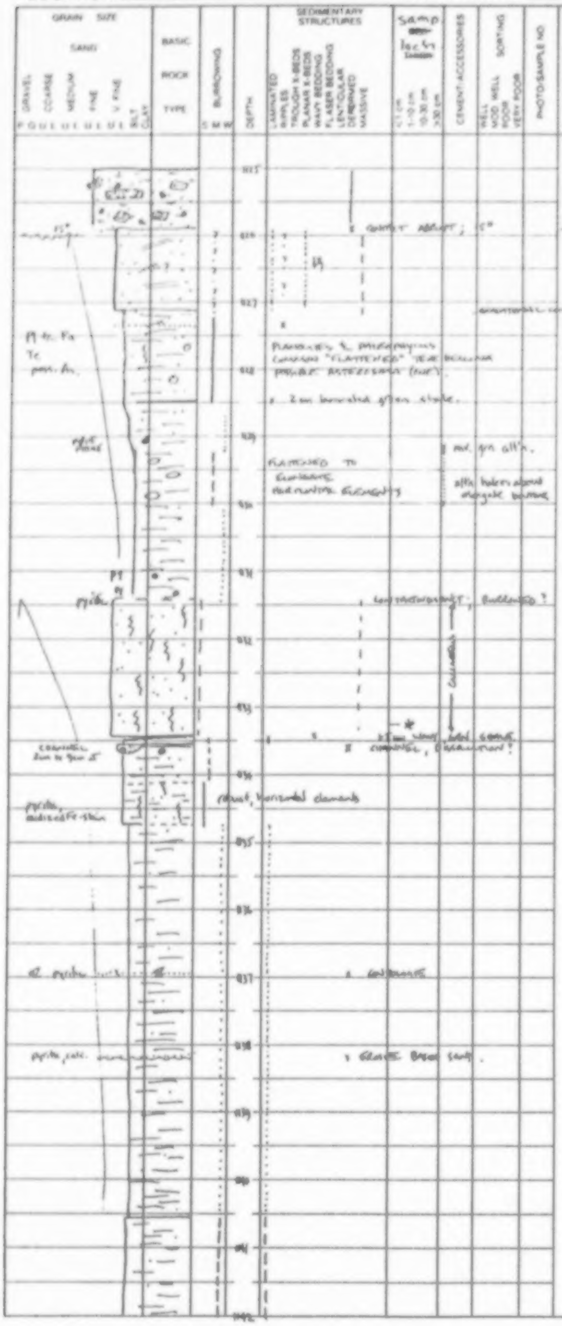
above 822.95:
· discrete mud laminae, non-calc
· wavy to discontinuous to ll laminae,
up to 1cm δ
· minor robust Planolites

FACIES DEP. ENVIRONMENT

p.142

WELL NAME: Union HB Walcemnt A-26-A
FORMATION: Charlie Lake - Doig
DATE: June 10th, 1994

LOCATION: d-26-A 194-H-2
CORE INTERVAL: 3690' - 3720'9" 1125m - 1133.5m
KB: 731.72


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
samp. lecty
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT/ACCESSORIES
SORTING
WELL
MOD. WELL
POOR
VERY POOR
PHOTO/SAMPLE NO.
1125
15°
contact abrupt; 15°
1126
1127
gradational contact.
Pl to Pa
Te
poss. As.
Planolites & Palaeophycus
common "flattened" Teichichnus
probable Asterosoma (rare)
1128
2 cm laminated green shale.
1129
pyrite stone
mod. grn alt'n.
flattened to elongate horizontal elements
alt'n halos around elongate burrows
1130
1131
Pl
Pl
pyrite
contact abrupt; burrowed?
1132
calcareous
1133
channel 2cm to 9cm Ø
1 cm wavy lam. coarse channel, erosion?
1134
pyrite, oxidized Fe-stain
robust, horizontal elements
1135
1136
pyrite
1137
Chondrites
pyrite, calc.
1138
graded base sand.
1139
1140
1141
1142

COMMENTS

Charlie Lake
dissolution/collapse breccia.
most clasts ≤ 1-2 cm
2 clasts 4cm x 7cm

v. fine sand
fairly homogeneous
no burrows identified
rare small pyrite nodules, non-calc.

slightly sandy silt w/ minor sand laminations (< 10%)

v. fine sand.
mottled (bioturbated) to mass. & structureless
calc.

interlaminated & homogenized:
tan-green silts, sandy silt, v. fine sand.
non-calc

planar to undulose (wavy?) laminations @ top.

silty muds ("Deep water"?)
rare silt and/or sand laminae
≤ few mm
planar to discontinuous
non-calc.

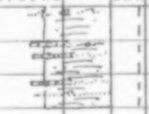
as above.
increase % silty sand interbeds
rare discrete planolites burrows c sand

FACIES DEP. ENVIRONMENT

p. 2 of 2

WELL NAME: ____ FORMATION: ____ DATE: ____

LOCATION: d-26-A/94-H-2 CORE INTERVAL: ____ KB: ____

| GRAIN SIZE: GRAVEL, SAND (COARSE, MEDIUM, FINE, V FINE), SILT, CLAY<br>P G U L U L U L U L | BASIC ROCK TYPE | BURROWING<br>S M W | DEPTH | SEDIMENTARY STRUCTURES: LAMINATED, RIPPLES, TROUGH X-BEDS, PLANAR X-BEDS, WAVY BEDDING, FLASER BEDDING, LENTICULAR, DEFORMED, MASSIVE | BED THICK<br><1 cm, 1-10 cm, 10-30 cm, >30 cm | CEMENT/ACCESSORIES | SORTING: WELL, MOD WELL, POOR, VERY POOR | PHOTO/SAMPLE NO | COMMENTS | FACIES DEP ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|
|  | | \| | 843 | [illegible], [illegible] | | | | | | |

[illegible]

WELL NAME: Union HB Woodmont d-34-A

FORMATION: Charlie Lake - Dow

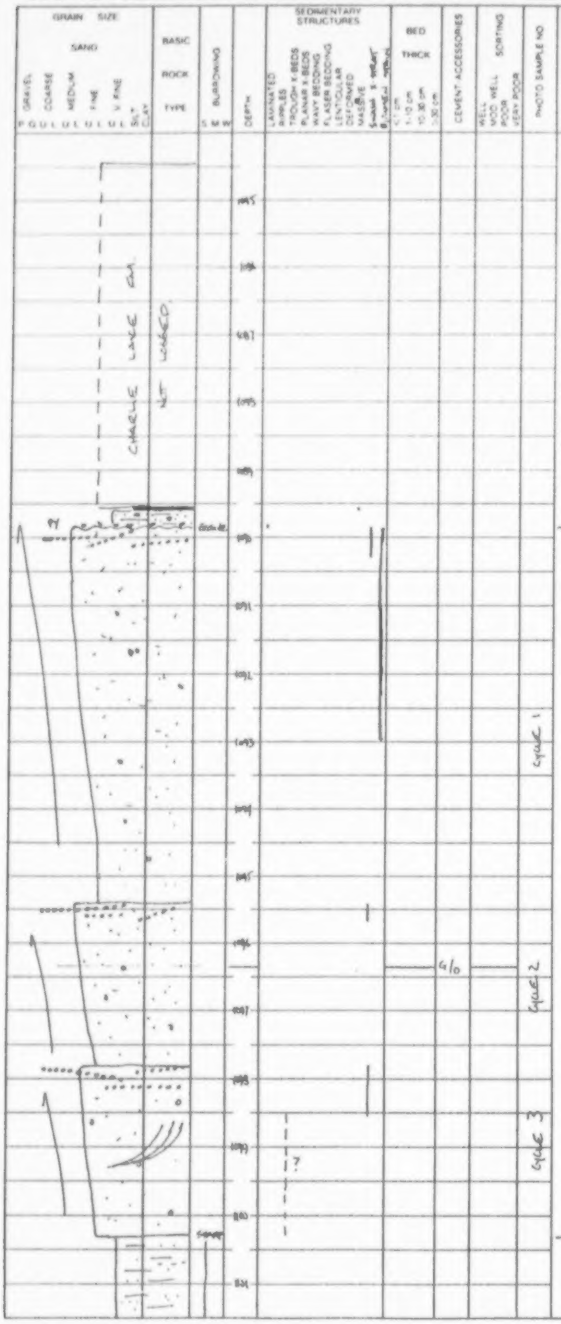
DATE: June 10th, 1994

3557' - 3616'10"

LOCATION: d-34-A / 94-H-2

CORE INTERVAL: 1084.95m - 1101.85m

KB: [illegible]



GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V FINE
SILT
CLAY
P G U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
SWASH X-STRAT
BIOTURBATED
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO SAMPLE NO
CHARLIE LAKE CM
NOT WASHED
Py
dolomite
1085
1086
1087
1088
1089
1090
1091
1092
1093
1094
1095
1096
1097
1098
1099
1100
1101
?
G/O
Cycle 1
Cycle 2
Cycle 3
sandy

COMMENTS

CONTACT:
- highly irregular, erosive, pyritized @ base
- randomly intermixed mud, sand, rip-ups
- 5cm mav black mud @ top
- 5cm finely laminated @ 1089.30-1089.85

3 crude coarsening up cycles
1) lower fine → medium
2) lower fine - upper fine
3) lower fine - upper fine

marked by 1-2 grain thick coarse - v. coarse pebble lags in upper segment each cycle bedded @ 0-3°

⇒ swash x-strat / ridge & runnel topography

pervasive bitumen stain over top 3m of Cycle 1.

interlaminated muddy & sandy silts

local silty mud and v fine sand lamina

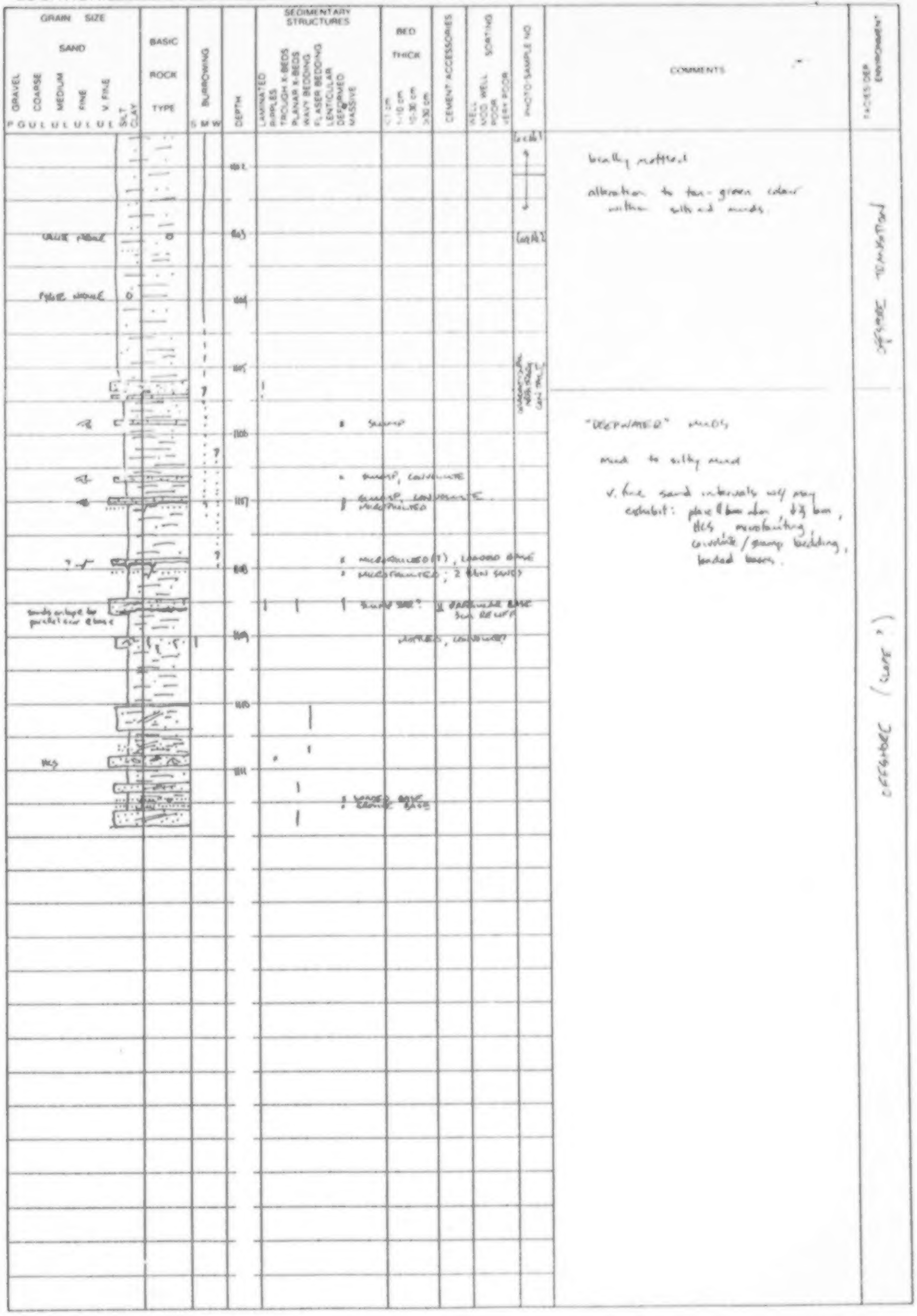
FACIES DEP. ENVIRONMENT

CHARLIE LAKE

U/C

SHOREFACE / SWASH ZONE

WELL NAME: ______
FORMATION: ______
DATE: ______
LOCATION: d-34-A /94-H-2
CORE INTERVAL: ______
KB: ______


GRAIN SIZE
SAND
GRAVEL
COARSE
MEDIUM
FINE
V. FINE
SILT
CLAY
P G U L U L U L U L U L
BASIC ROCK TYPE
BURROWING
S M W
DEPTH
SEDIMENTARY STRUCTURES
LAMINATED
RIPPLES
TROUGH X-BEDS
PLANAR X-BEDS
WAVY BEDDING
FLASER BEDDING
LENTICULAR
DEFORMED
MASSIVE
BED THICK
<1 cm
1-10 cm
10-30 cm
>30 cm
CEMENT ACCESSORIES
SORTING
WELL
MOD WELL
POOR
VERY POOR
PHOTO/SAMPLE NO
COMMENTS
FACIES/DEP. ENVIRONMENT
1102
1103
1104
1105
1106
1107
1108
1109
1110
1111
CALCITE NODULE
PYRITE NODULE
sands onlap to parallel scour base
HCS
SLUMP
SLUMP, CONVOLUTE
SLUMP, CONVOLUTE. MICROFAULTED
MICROFAULTED (?), LOADED BASE
MICROFAULTED ; 2 (thin sands)
SLUMP SEE? EROSIVE BASE 3cm RELIEF
MOTTLED, CONVOLUTE?
WAVED BASE
EROSIVE BASE
(core ph 1)
(core ph 2)
gradational contact
OFFSHORE TRANSITION
OFFSHORE (SLOPE ?)

locally mottled

alteration to tan-green colour within silt and muds.

"DEEPWATER" MUDS

mud to silty mud

v. fine sand intervals may exhibit: parallel lam, x-lam, HCS, microfaulting, convolute/slump bedding, loaded bases.

# APPENDIX G: DOIG STUDY

## DOIG POOL SUMMARIES AND PRODUCTION STATISTICS

# Buick Creek

## POOL SUMMARY

|  | Doig A Pool<br>Inverness Project |  | Doig B Pool<br>Poco Project |  |
|---|---|---|---|---|
|  | OIL | GAS | OIL | GAS |
| **Reservoir Characteristics** |  |  |  |  |
| **Net Sand** | 6.2m Oil Pay | 7.3m Gas Pay | 6.7m Oil Pay | 4.3m Gas Pay |
| **Petrophysics** |  |  |  |  |
| **Porosity Type** |  |  |  |  |
| **Poros** | 9.40% | 7.30% | 10.20% | 9.10% |
| **Depth** |  |  |  |  |
| **Thickness (1)** |  |  |  |  |
| **Area** | 65 ha | 26ha | 249ha | 226ha |
| **Fluid Data** |  |  |  |  |
| **Saturation** | 8.50% | 12.20% | 7.90% | 8.80% |
| **API Gravity** | 43.5 |  | 43.5 |  |
| **Gas-Oil Ratio** | 159.6 |  |  |  |
| **Production Data** |  |  |  |  |
| **Type** | OIL | GAS | OIL | GAS |
| **In Place Volume** | 1,504,003 bbls | 1.7 bcf | 6,796,332 bbls | 10.9 bcf |
| **Cumm. Production** | 276,888 bbls | 0.6 bcf | 748,855 bbls | 8.4 bcf |
| **Est. Reserves** | 24,542 bbls | 0.3 bcf | 269,965 bbls | 1.4 bcf |
| **Recovery Factor** | 20% | 90% | 15% | 90% |
| **Remarks** |  |  |  |  |
| **Discovery Date** | 1977 |  | 1976 |  |
| **Discovery Well** | d-46-I/94-A-11 |  | a-67-I/94-A-11 |  |
| **Operator** | Skye |  | Poco |  |
| **Last Update** | Mar-93 |  | Aug-92 |  |
| **Initial Classification** | Lower Halfway A Pool |  | Lower Halfway B Pool |  |

## COMMENTS

# Buick Creek

## POOL SUMMARY

| | Doig D Pool | Doig - Undesignated | Doig - Undesignated |
|---|---|---|---|
| **Reservoir Characteristics** | | | |
| **Net Pay** | 6.8m Oil Pay | 21.4m Oil Pay | 11.9m Oil Pay |
| **Petrophysics** | | | |
| **Porosity Type** | | | |
| **Porosity** | 10.40% | 9.60% | 10.10% |
| **Depth** | | | |
| **Thickness (1)** | | | |
| **Area** | 0 | 65ha | 65ha |
| **Fluid Data** | | | |
| **Saturation** | 5.80% | 6.10% | 4.20% |
| **API Gravity** | 42.8 | 45.2 | 44.9 |
| **Gas-Oil Ratio** | | 129 | 166 |
| **Production Data** | | | |
| **Type** | | | |
| **In Place Volume** | 3,649,882 bbls | 5,802,054 bbls | 3,039,470 bbls |
| **Cumm. Production** | 75,515 bbls | 18,879 bbls | 25,172 bbls |
| **Est. Reserves** | 291,361 bbls | 1,140,273 bbls | 584,610 bbls |
| **Recovery Factor** | 10% | 20% | 20% |
| **Remarks** | | | |
| **Discovery Date** | 1990 | 1990 | 1991 |
| **Discovery Well** | d-86-I/94-A-11 | 9-34-88-20/w6 | d-76-I/94-A-11 |
| **Operator** | Esso | Esso | Esso |
| **Last Update** | Jan-94 | Aug-92 | Aug-92 |
| **Initial Classification** | Lower Halfway C Pool | Lower Halfway E Pool | Lower Halfway F Pool |

## COMMENTS

# Cache Creek

## RESERVOIR SUMMARY

| | |
|---|---|
| **General** | |
| **Location** | I/94-A-12 - 65 km northwest of Fort St. John, B.C. |
| **Tectonics** | Ramp-type passive margin.<br>North flank of the Fort St. John Graben and Hay River Fault Zone. |
| **Trap Mechanism** | Stratigraphic - overlying deep water silts and mud |
| **Source Rock** | Presumed Doig Phosphate Zone source |
| **Reservoir Rocks** | |
| **Age** | Middle Triassic - Anisian/Ladinian? |
| **Stratigraphic Unit** | Doig - 2nd sand equivalent |
| **Lithology** | Sandstone - fine to very fine grained |
| **Dep. Environment(s)** | Lower shoreface - lowstand systems tract? |
| **Productive Facies** | Sands associated with toe of slope below incised shoreface |

| | **Doig A Pool** | **Doig B Pool** |
|---|---|---|
| **Reservoir Characteristics** | | |
| **Net Sand** | 6.3m Gas Pay | 2.0m Oil Pay |
| **Petrophysics** | | |
| **Porosity Type** | intergranular | intergranular |
| **Porosity** | 9.10% | 9.20% |
| **Depth to Producing Sand** | 1643m | 1694m |
| **Thickness** | 6.5m | 5.0m |
| **Area** | 259 ha | 48 ha |
| **Fluid Data** | | |
| **Water Saturation** | 21.40% | 19.20% |
| **API Gravity** | 41 | 45.8 |
| **Gas-Oil Ratio** | | 227 |
| **Production Data** | | |
| **Type** | GAS | OIL |
| **In Place Volume** | 10 bcf | 27, 689 bbls |
| **Cumm. Production** | 0 | |
| **Est. Reserves** | 0.007 bcf | 0 |
| **Recovery Factor** | 0.20% | 0.30% |
| **Remarks** | | |
| **Discovery Date** | 1978 | 1979 |
| **Discovery Well** | b-62-I/94-A-12 | b-64-I/94-A-12 |
| **Operator** | Cdn Roxy | Czar |
| **Last Update** | May-88 | Sep-85 |

## COMMENTS

Both pools represent 1-well pools. Depleted.

Core available and logged through base of sand in Doig B Pool (b-64-I/94-A-12).

Data Source: Hydrocarbon and By-Product Reserves in British Columbia - 1993.

# Fireweed

## RESERVOIR SUMMARY

| | |
|---|---|
| **General** | |
| **Location** | D/94-A-14 - 67 km northwest of Fort St. John, B.C. |
| **Tectonics** | Ramp-type passive margin.<br>North flånk of the Fort St. John Graben and Hay River Fault Zone. |
| **Trap Mechanism** | Stratigraphic - overlying deep water silts and mud |
| **Source Rock** | Presumed Doig Phosphate Zone source |
| **Reservoir Rocks** | |
| **Age** | Middle Triassic - Anisian/Ladinian? |
| **Stratigraphic Unit** | Doig - 2nd sand equivalent |
| **Lithology** | Sandstone - fine to very fine grained |
| **Dep. Environment(s)** | Lower shoreface - lowstand systems tract? |
| **Productive Facies** | Sands associated with incised shoreface. |

| | Doig A Pool | | Doig B Pool | |
|---|---|---|---|---|
| **Reservoir Characteristics** | | | | |
| **Net Sand** | 15.5m Oil Pay | | 5.6m Oil Pay | |
| **Petrophysics** | | | | |
| **Porosity Type** | intergranular | | intergranular | |
| **Porosity** | 9.00% | | 9.00% | |
| **Depth to Producing Sand** | 1650.7m | | 1639m | |
| **Thickness (1)** | 17m | | 11m | |
| **Area** | 0 | | 0 | |
| **Fluid Data** | | | | |
| **Water Saturation** | 10.00% | | 10.70% | |
| **API Gravity** | 42 | | 42 | |
| **Gas-Oil Ratio** | 212.8 | | 212.8 | |
| **Production Data** | | | | |
| **Type** | OIL | GAS | OIL | GAS |
| **In Place Volume** | 503,432 bbls | 1.56 bcf | 182,494 bbls | 0.567 bcf |
| **Cumm. Production** | 18,879 bbls | 0.07 bcf | 6,293 bbls | 0.035 bcf |
| **Est. Reserves** | 32,094 bbls | 1.096 bcf | 11,327 bbls | 0.394 bcf |
| **Recovery Factor** | 10.00% | 90% | 10.00% | 90% |
| **Remarks** | | | | |
| **Discovery Date** | 1978 | | 1978 | |
| **Discovery Well** | b-26-D/94-A-14 | | b-06-D/94-A-14 | |
| **Operator** | Czar ? | | PetroCanada | |
| **Last Update** | Dec-78 | | Dec-78 | |

## COMMENTS

1 Sand thickness based on 60 API cutoff.

Both pools represent 1-well pools.

Core available and logged through base of sand in both pools.

Data Source: Hydrocarbon and By-Product Reserves in British Columbia - 1993.

# Red Creek/Red Creek - North

## RESERVOIR SUMMARY

| | | |
|---|---|---|
| **General** | | |
| **Location** | Twp 85N/R21w6 (Red Creek) - 27km northwest of Fort St. John, B.C.<br>Twp 86N/R21w6 (Red Creek North) - 35km northwest of Fort St. John, B.C. | |
| **Tectonics** | Ramp-type passive margin<br>Due north of Peace River arch, Fort St. John Graben, and Dawson Creek Graben | |
| **Trap Mechanism** | Stratigraphic - overlying massive silts and muds | |
| **Source Rock** | Presumed Doig Phosphate Zone source | |
| **Reservoir Rocks** | | |
| **Age** | Middle Traissic - Anisian/Ladinian? | |
| **Stratigraphic Unit** | Doig - 2nd sand equivalent (?) | Red Creek - North now classified as Halfway pool |
| **Lithology** | Sandstone - very fine to fine grain | |
| **Dep. Environment(s)** | | |
| **Productive Facies** | | |

| | **Red Creek** | **Red Creek - North** |
|---|---|---|
| **Reservoir Characteristics** | **(Doig B)** | **(reclassified as Halfway pool)** |
| **Net Sand** | 13.4m Oil Pay | 3.3m Gas Pay |
| **Petrophysics** | | |
| **Porosity Type** | intergranular ? | Intergranular ? |
| **Porosity** | 8.20% | 8.80% |
| **Depth to Producing Sand** | 1536m | n/a |
| **Thickness (1)** | 19.5m | n/a |
| **Area** | 0 | 2350 ha |
| **Fluid Data** | | |
| **Saturation** | 15% | 33% |
| **API Gravity** | 42.8 | 42.8 |
| **Gas-Oil Ratio** | 159.6 | n/a |
| **Production Data** | | |
| **Type** | OIL | GAS |
| **In Place Volume** | 352,402 bbls | 25.38 bcf |
| **Cumm. Production** | 18,879 bbls | 0 |
| **Est. Reserves** | 0 | 20.29 bcf |
| **Recovery Factor** | 5% | 80% |
| **Remarks** | | |
| **Discovery Date** | 1976 | 1976 |
| **Discovery Well** | 11-15-85-21 | 11-8-86-21 |
| **Operator** | Peace Petroleum | Pacific Petroleums |
| **Last Update** | Dec-78 | Mar-91 |

## COMMENTS

1 Sand thickness based on 60 API cutoff.

Both pools represent one-well pools; Red Creek - North has subsequently been reclassified as a Halfway pool.

Core available in 11-31-85-21/w6. No core in either pool.

Data Source: Hydrocarbon and By-Product Reserves in British Columbia - 1993.

## Rigel

### RESERVOIR SUMMARY - DOIG A POOL

| | |
|---|---|
| **General** | |
| **Location** | NE/4 Twp 88N/R16 w6 - 51km northeast of Fort St. John, B.C. |
| **Tectonics** | Ramp type passive margin<br>North flank Peace River Arch, Fort St. John and Dawson Creek grabens. |
| **Trap Mechanism** | Stratigraphic - overlying deep marine silts and muds. |
| **Source Rock** | Presumed Doig Phosphate Zone source. |
| **Reservoir Rocks** | |
| **Age** | Middle Traissic - Anisian/Ladinian? |
| **Stratigraphic Unit** | Doig sand - pre 1st Sand Equivalent? |
| **Lithology** | Sandstone. |
| **Dep. Environment(s)** | unknown |
| **Productive Facies** | unknown |
| **Reservoir Characteristics** | |
| **Net Pay** | 4.5m Oil Pay |
| **Petrophysics** | |
| **Porosity Type** | intergranular ? |
| **Porosity** | 6.70% |
| **Depth to Producing Sand** | 1251m |
| **Thickness (1)** | 6.0m |
| **Area** | 65 ha |
| **Fluid Data** | |
| **Saturation** | 36.00% |
| **API Gravity** | 39.6 |
| **Gas-Oil Ratio** | 74.4 |
| **Production Data** | |
| **Type** | OIL |
| **In Place Volume** | 648,169 bbls |
| **Cumm. Production** | 0 |
| **Est. Reserves** | 129,004 bbls |
| **Recovery Factor** | 20% |
| **Remarks** | |
| **Discovery Date** | 1990 |
| **Discovery Well** | 15-29-88-16 |
| **Operator** | Amoco |
| **Last Update** | May-91 |

### COMMENTS

1 Sand thickness based on 60 API cutoff.

Core available, not logged. Less than 0.5m of reservoir cored (?) - remainder Halfway/Charlie Lake core.

Data Source: Hydrocarbon and By-Product Reserves in British Columbia - 1993.

# Stoddart - West

## RESERVOIR SUMMARY - DOIG A POOL

| | |
|---|---|
| **General** | |
| **Location** | Twp 87N/R20 w6 - 37km north-northwest of Fort St. John, B.C. |
| **Tectonics** | Ramp type passive margin<br>North flank Peace River Arch, Fort St. John and Dawson Creek grabens. |
| **Trap Mechanism** | Stratigraphic - overlying deep marine silts and muds. |
| **Source Rock** | Presumed Doig Phosphate Zone source. |
| **Reservoir Rocks** | |
| **Age** | Middle Traissic - Anisian/Ladinian? |
| **Stratigraphic Unit** | Doig - 1st Sand Equivalent. |
| **Lithology** | Sandstone - Fine grain. |
| **Dep. Environment(s)** | Probable lower-middle shoreface - lowstand systems tract/incised shoreface. |
| **Productive Facies** | Sands preserved within shoreface following subsequent transgressive erosion. |
| **Reservoir Characteristics** | |
| **Net Pay** | 11.9m Oil Pay |
| **Petrophysics** | |
| **Porosity Type** | intergranular ? |
| **Porosity** | 8.20% |
| **Depth to Producing Sand** | 1591m |
| **Thickness (1)** | 18.3m |
| **Area** | 65 ha |
| **Fluid Data** | |
| **Saturation** | 20.40% |
| **API Gravity** | 45.8 |
| **Gas-Oil Ratio** | 133 |
| **Production Data** | |
| **Type** | OIL |
| **In Place Volume** | 44,050 bbls |
| **Cumm. Production** | 0 |
| **Est. Reserves** | 0 |
| **Recovery Factor** | 1% |
| **Remarks** | |
| **Discovery Date** | 1977 |
| **Discovery Well** | 7-21-87-20 |
| **Operator** | J M.Huber |
| **Last Update** | Jan-87 |

## COMMENTS

1 Sand thickness based on 60 API cutoff.

One-well pool.

Core available in 06-22-86-20/w6. No core in pool.

Data Source: Hydrocarbon and By-Product Reserves in British Columbia - 1993.

## Stoddart - West

### RESERVOIR SUMMARY - DOIG B & C POOLS

| | |
|---|---|
| **General** | |
| **Location** | Twp 86N/Range 20 w6 - 25km north-northwest of Fort St. John, B.C. |
| **Tectonics** | Ramp type passive margin<br>North flank Peace River Arch, Fort St. John and Dawson Creek grabens. |
| **Trap Mechanism** | Stratigraphic - overlying deep marine silts and muds. |
| **Source Rock** | Presumed Doig Phosphate Zone source. |
| **Reservoir Rocks** | |
| **Age** | Middle Traissic - Anisian/Ladinian? |
| **Stratigraphic Unit** | Doig - 1st Sand Equivalent. |
| **Lithology** | Sandstone - Fine grain. |
| **Dep. Environment(s)** | Probable lower-middle shoreface - lowstand systems tract/incised shoreface. |
| **Productive Facies** | Sands preserved within shoreface following subsequent transgressive erosion. |

| | Doig B Pool | Doig C Pool |
|---|---|---|
| **Reservoir Characteristics** | | |
| **Net Pay** | 2.0m Oil Pay | 0.7m Oil Pay |
| **Petrophysics** | | |
| **Porosity Type** | intergranular | intergranular |
| **Porosity** | 10% | 11.30% |
| **Depth to Producing Sand** | 1567m | 1578m |
| **Thickness (1)** | 3m (19m silt eq.) | 1.5m (9.5m silt eq.) |
| **Area** | 195 ha | 117 ha |
| **Fluid Data** | | |
| **Saturation** | 13.90% | 12.10% |
| **API Gravity** | 43 | 41.5 |
| **Gas-Oil Ratio** | 133 | 138.2 |
| **Production Data** | | |
| **Type** | OIL | OIL |
| **In Place Volume** | 1,516,589 bbls | 364,988 bbls |
| **Cumm. Production** | 201,373 bbls | 62,929 bbls |
| **Est. Reserves** | 103,833 bbls | 10,698 bbls |
| **Recovery Factor** | 20% | 20% |
| **Remarks** | | |
| **Discovery Date** | 1980 | 1987 |
| **Discovery Well** | 16-4-86-20 | 6-14-86-20 |
| **Operator** | Scurry Rainbow | Mark Resources |
| **Last Update** | Mar-93 | May-91 |

### COMMENTS

1 Sand thickness based on 60 API cut-off.

Cores available in (02)6-4-86-20 and 12-4-86-20 (B Pool), 16-15-86-20, and 10-25-86-20.

Data Source: Hydrocarbon and By-Product Reserves in British Columbia - 1993.

# Wildmint

## RESERVOIR SUMMARY - DOIG/LOWER HALFWAY POOLS

| | |
|---|---|
| **General** | |
| **Location** | A/94-H-02 and I/94-A-15 - 87km north-northeast of Fort St. John, B.C. |
| **Tectonics** | Ramp type passive margin<br>North flank Fort St. John and Dawson Creek grabens, and Hay River Fault Zone. |
| **Trap Mechanism** | Stratigraphic/erosional - lateral seal against deep water silts/mud;<br>updip seal against internal Charlie Lake unconformity |
| **Source Rock** | Presumed Doig Phosphate Zone source. |
| **Reservoir Rocks** | |
| **Age** | Middle Traissic - Anisian/Ladinian? |
| **Stratigraphic Unit** | Mixed Doig/Halfway, depending on depth of erosion. |
| **Lithology** | Sandstone - Fine grain. |
| **Dep. Environment(s)** | Probable middle shoreface/upper shoreface. |
| **Productive Facies** | Variable erosional remnants of shoreface sands. |

| | OIL | GAS |
|---|---|---|
| **Reservoir Characteristics (1)** | (3 pools) | (2 pools) |
| **Net Pay (Average)** | | |
| **Net Pay (Range)** | 1.0m - 5.5m | 5.8m - 15.0m |
| **Petrophysics** | | |
| **Porosity** | ~ 14% | ~ 14% |
| **Porosity Range** | 9% - 14% | 10.8% - 14.2% |
| **Depth** | | |
| **Thickness (2)** | | |
| **Total Area (all pools)** | 376ha | 130ha |
| **Fluid Data (1)** | | |
| **Saturation** | 16.7% - 34.4% | <15% |
| **API Gravity (Range)** | 40 | 40 |
| **Gas-Oil Ratio** | < 60 | |
| **Production Data (3)** | | |
| **Type** | OIL | GAS |
| **In Place Volume** | 3,372,994 bbls | 4.8 bcf |
| **Cumm. Production** | 295,766 bbls | 1.1 bcf |
| **Est. Reserves** | 118,936 bbls | 2.9 bcf |
| **Recovery Factor** | 0.3% - 20% | 90% |

## COMMENTS

1 Average characteristics estimated based on all pools (3 oil, 2 gas).
2 Sand thickness based on 60 API cut-off.
3 Cummulative data based on sum of all pools.

Discovery wells cored and logged in Doig B, Doig C/Halfway G, and Doig F pools: 8 cores logged in general field area.

Data source: Hydrocarbon and By-Product Reserves in British Columbia - 1993.

## Wildmint

### POOL SUMMARY

| | Doig A Pool | Doig B Pool<br>(plus UNOCAL Project)<br>Oil | <br><br>Gas | Doig D Pool | Doig F Pool |
|---|---|---|---|---|---|
| **Reservoir Characteristics** | | | | | |
| **Net Sand** | 2.0m Oil Pay | 1.0m Oil Pay | 5.8m Gas Pay | 5.5m Oil Pay | 15.0m Gas Pay |
| **Petrophysics** | | | | | |
| **Porosity Type** | | | | | |
| **Porosity** | 10% | 14% | 14.20% | 9.10% | 10.80% |
| **Depth** | | | | | |
| **Thickness (1)** | | | | | |
| **Area** | 130ha | 181ha | 130ha | 65ha | 0 |
| **Fluid Data** | | | | | |
| **Saturation** | 18.70% | 34.40% | 34.10% | 24% | 12.40% |
| **API Gravity** | 40 | 40 | | 40 | |
| **Gas-Oil Ratio** | 58.5 | 45.9 | | 45.9 | |
| **Production Data** | | | | | |
| **Type** | OIL | OIL | GAS | OIL | GAS |
| **In Place Volume** | 1,113,843 bbls | 975,400 bbls | 4.4 bcf | 1,283,752 bbls | 0.3 bcf |
| **Cumm. Production** | 195,080 bbls | 100,686 bbls | 1.0 bcf | 0 | 0.1 bcf |
| **Est. Reserves** | 25,801 bbls | 91,876 bbls | 2.9 bcf | 1,259 bbls | 0.03 bcf |
| **Recovery Factor** | 20% | 20% | 90% | 0.30% | 40% |
| **Remarks** | | | | | |
| **Discovery Date** | 1963 | 1962 | | 1965 | 1965 |
| **Discovery Well** | d-94-I/94-A-15 | d-15-A/94-H-02 | | d-13-A/94-H-02 | d-84-I/94-A-15 |
| **Operator** | Esso | Union Oil | | Medallion | Pacific Petroleums |
| **Last Update** | Apr-89 | Mar-91 | | Apr-89 | Jul-89 |

### COMMENTS

1 Sand thickness based on 60 API cutoff.

Doig C Pool reclassified as Halfway G Pool - not included in summary.

No data available for Doig E Pool (oil?) - not included in summary.